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Specimen

Plate

in

NOËL DEERR'S

SUGAR . . .

AND THE . .

SUGAR CANE.

(See page X.)

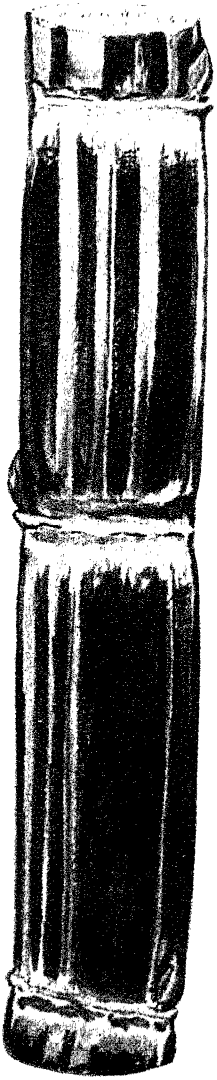

FIG. 13.
STRIPED
BAMBOO.

$\frac{2}{3}$
SIZE

THE
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SUGAR JOURNAL.

No. 85. JANUARY, 1906. Vol. VIII.

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NOTES AND COMMENTS.

A Change of Government.

The long rule of the Unionists has at length come to an end, and a Liberal Government reigns in their stead. We cannot say we welcome the change, for the party which is recruited largely from Little Englanders, Home Rulers, and Cobdenites, has not legislated in the past, and will not, we fear, do so in the future, so as to safeguard the interests of sugar production in the British Empire. Their outlook has not extended beyond the family table, and hence their view of the problem may be summed up in the cry, "Give us cheap sugar—never mind where it comes from." Had Liberals been as liberal-minded during the past decade as the Unionists have mostly been, we might now have been able to record the *success* of a home beet sugar cultivation, and of a colonial cane sugar industry. But the prospects of one, and the prosperity of the other, are still but dreams. We fear there is little chance of our farmers taking largely to beet sugar cultivation until they are assured of some Government support. Here or there attempts may be made, and possibly with moderate success under present conditions: but the concensus of opinion amongst those who may be looked to to advance the funds seems to be that until our native industry can receive at least some of the benefit of 2s. 6d. per cwt. allowed by the surtax clause, it will be a risky proceeding to erect central beet sugar factories in this country. And what can be expected in this direction from a Government composed of men who, with almost one voice, denounced the Brussels Convention when it came up for ratification in the House of Commons? Still, the extent to which the new Government will venture to modify the present conditions, under which the sugar industry exists, will depend very largely upon the majority they secure at the coming election. If the Unionists succeed in rallying their somewhat scattered ranks, they may at the least leave the Radicals with so small a majority as to make them powerless for evil. We trust this may come to pass, as we have no wish to see the present Government in office when the Brussels Convention comes up for renewal.

The Cabinet.

On the whole Sir Henry Campbell-Bannerman has got together a fairly strong Cabinet. It is certainly strong in diplomacy, as Sir Edward Grey's choice for the Foreign Office shows. But it lacks men of wide business experience, and it contains too many lawyers. What good is a lawyer at the Board of Trade? Why was not a man like Sir W. H. Holland chosen for that post? Amongst the smaller fry who are not in the Cabinet we find Mr. Winston Churchill as Under-Secretary for the Colonies. We hope he will not succeed in undermining the numerous reforms Mr. Chamberlain introduced during his tenure of office. Likewise we note our old friend, Mr. Thomas Lough, at the Board of Education; and Mr. Kearley, who led the denunciation of the Brussels Convention in the House of Commons last February, has, we see, been appointed Parliamentary Secretary to the Board of Trade. These three last-mentioned gentlemen are exponents of the "cheap sugar" school, and we have no doubt they will do their best to bring back the old condition of things, when sugar prices rose and fell like Atlantic billows. Whether they will succeed in their desire is another matter, and we can but wait and watch the course of events.

More Central Factories.

The success of the Antigua Central Factories ought to prove a powerful argument in support of those reformers who desire to see similar factories in Barbados and Trinidad. Hitherto, in spite of the attempts made by Sir D. Morris and Prof. J. B. Harrison to get the Barbados planters to move in the matter, the latter have been too wedded to old methods to do anything. They cannot, however, go on indefinitely wasting 40% of their raw material; and now that Antigua sugar is proving better and more profitable than the one time famous Barbados brands, Barbadians may, it is hoped, throw off their conservatism and go in for large up-to-date central factories. If they do not, they will only have themselves to thank if ruin overwhelms them.

There are doubtless many people left who like the Barbados old-fashioned raw sugar; but we very much question whether the demand for it will remain great enough as to warrant its manufacturers defying all progressive methods and scientific manufacture. We are glad to see that the Barbados Press realizes this, and advocates speedy reform.

A New Mill for Berbice.

We learn that Messrs. George Fletcher & Co., Derby, have just constructed a new mill for Port Mourant Plantation, Berbice, British Guiana. It consists of a very powerful three-roller mill, with cane crushing rollers attached, the five rollers being driven by one engine. The latter is moreover arranged so as to drive not only the five rollers already mentioned, but also additional mills which will probably be added later on, thus converting the grinding plant into an eleven-roller mill. We may have occasion in a later issue to describe the plant more fully.

Chinese Aliens in Australia.

A correspondent in the *Times* states that large numbers of cane growers in North Queensland have thrown up their farms and leased them to Chinamen. The way these Chinamen are getting into Australia is curious. The Immigration Restriction Act can only apply within three miles of the Australian coast. But in Torres Straits, where pearl fisheries are established and the pearl grounds are mostly outside the three-mile limit, the pearlers put to sea with a limited crew. When well out at sea, they meet other craft from China, which transfer large numbers of aliens to them. These latter are landed in Australia, and if any inspectors accost them they are met with a positive declaration that these Chinamen, who are now at work sorting pearls, were taken out in the boat as the original crew. But once the coast is clear, they go inland and seek work on the farms.

We would draw attention to the advertisement in our present number regarding the Clyde Sugar Refinery, Greenock, which is again being offered for sale by public auction at the end of this month. When the refining industry in that Scotch centre is once more brisk, it seems a pity that an establishment, which might employ a large number of men, should be lying idle. We trust that this time some purchaser may be found. Messrs. McArthur & Orkney, Consulting Engineers, Cathcart Street, Greenock, are, as heretofore, the agents to whom to apply for an inspection of the Refinery.

THE SUGAR CONVENTION AS A PARTY CRY.

Three years ago M. Yves Guyot, the eminent French economist, read a paper before our Royal Statistical Society in which he exposed the vices of the bounty system with great power and lucidity. His concluding words were as follows:—

"The success of the Sugar Conference is the most important achievement of economic liberal policy in Europe since the signing of the Commercial Treaties of 1860."

The opponents of the Sugar Convention have probably never read this declaration; many of them are very likely unaware of M. Yves Guyot's existence; all of them will under any circumstances and in spite of conclusive proofs, repudiate his views, shut their ears, and continue to cry "Great is Diana of the Ephesians."

The most incredible point in the opposition is that it takes its stand on the sacred principles of Free Trade.

Bounties arise from other sources than the mere payment of subsidies. A heavy protective duty in Germany, for instance, enables an industry to obtain an abnormal price in the home market, and consequently stimulates over-production, the surplus being sold for export and pressed on over-loaded markets at a price with which natural producers are unable to compete. This is the trouble with which Mr. Balfour proposes to grapple by compelling the reduction of the protection and the consequent abolition of the unfair competition. That is what the Brussels Convention succeeded in achieving with regard to sugar. The foreigner was practically protected in British markets; his produce was in the same position as if it were admitted free while his British competitors were subject to an import duty. The Brussels Convention declares that this shall no longer be permitted, and that equality of treatment shall be restored by the abolition of the bounty or its removal by a countervailing duty. The Convention thus simply restores free trade in sugar.

The so-called Free Traders, on the other hand, never cease to cry that the admission of foreign bounty-fed produce is the essence of Free Trade, and that any attempt to stop such a salutary state of things is Protection of the most virulent kind. "Cheap sugar," they cry, "that is all we ask for."

This is their shallow Political Economy. They do not take the trouble to consider, for a moment, what effect the sale of surplus production on an over-stocked market has on the real permanent interests of the consumer. It means, in the first place, the sale of goods below cost price. What effect must this have on the production of the commodity? Can natural producers continue to compete? If not, what is the result? Reduced production, depleted stocks and a rise in price. The thing is inevitable, and has occurred at regular intervals during the twenty years of bounties; the result being that the consumer, *on the average*, paid more money for his sugar than he would have done if there had been no bounties and no falls below cost price. These are facts, not theories.

After going so far in the consideration of this question, the reader may well ask how there can possibly be any further opposition to the policy of the Sugar Convention. The reply is that party warfare is quite indifferent to facts. Fiction is found to go down better in the long run. The literature of the "Sugar Question" is full of fabulous stories, which are read and swallowed with the same avidity that devours periodically the Penny Dreadful.

The opposition began by declaring that when bounties were abolished British consumers would have to pay £8,000,000 more for their sugar. This figure they arrived at by multiplying our consumption by the amount of the bounty, thus showing that they were unacquainted with the rudiments of the subject of market prices. It is quantity alone that governs price. The bounties, though they caused a temporary increase in quantity, were bound in the long run to bring about an enormous decrease in competition, a great falling off in production, a gradual monopoly in the hands of the few countries which gave the bounties, and a consequent increase in price.

When the Convention came into force the opposition were surprised to find that, far from their prophesy coming true, prices were more inclined to fall than to rise. Then an accident came to their rescue. A great drought in the summer of 1904 reduced the crop of beetroot sugar in Europe from 5,700,000 tons to 4,600,000 tons, a sudden loss of more than a million tons of sugar. The bounties have made the world dependent upon the beetroot crop for more than half its supply of sugar, and therefore this accident to the crop had a serious effect on prices. Speculators forced them up from below 8s. per cwt. to above 16s. This was clearly a rise caused by our being dependent on the beetroot crop for our supplies; which was the inevitable effect of bounties, in stimulating over-production in Europe and discouraging it elsewhere. The rise was, therefore, purely the effect of the bounties, coupled with the accident to the crop. But the opposition try to make the public believe—without a shred of proof—that the Convention caused the rise.

Then came the reaction. Speculators, as usual, were caught with large stocks which they could not liquidate on a flat market, and prices went back to 8s. Consumption had fallen off, visible stocks consequently increased unexpectedly, and the sugar producers in Europe, stimulated by the rise, sowed an enormously increased acreage for the 1905 crop. Here, again, we have an illustration of our dependence on the beetroot crop, brought about by bounties. The sugar factories of Europe are now, owing to bounties, capable of turning out, when working full in a good season, nearly seven million tons of sugar, out of a visible world's consumption of about ten million tons. No wonder we have these violent fluctuations; first a great rise when a bad crop comes, and then an equally violent fall when too much land is cultivated with beetroot. This has happened periodically.

The Convention will remedy all this by making supply to depend—and with it competition—solely on the natural cost of production. This seems sufficiently simple and manifest, but the opposition are not aware of it, they are still up in a balloon, and still cry aloud that all this clear and intelligible result of the vicious system of artificial interference with the natural course of industry is caused by the very International arrangement which has destroyed the evil and will eventually restore health and vitality, with permanent low prices governed only by cost of production.

Among the misleading literature which is now flooding the country we find a pamphlet entitled "The Sugar Convention, its cost and consequences." A careful analysis of its contents exposes a mass of disjointed assertions, without argument or proof of any kind, every one of which is absolutely without foundation. It is a dry task to expose these false statements, and still drier for the reader to examine the exposition. But the above explanation of the facts of the situation renders further argument unnecessary, and all that remains is a brief exposure of ridiculous and wanton assertions.

The word "Restrictions" is the keynote of the essay. There are two countries which still persist in giving bounties, and their produce is therefore, in order to maintain free competition, penalized under the terms of the Convention. Russia and Argentina are occasional exporters of sugar to Europe, but as regards Russia the exports go mostly to the East or to Finland, and Argentine sugar finds many outlets beyond Europe. But in any case it is manifest that the world's consumption has to be supplied by the world's production, and it matters not how the sugar is distributed. Wherever Russian or Argentine sugar goes it displaces some other sugar which can come here instead. Our price is the world's price, prices in Hamburg and London are identical, and therefore we are not in any way affected by the absence of Russian sugar on our markets. As a matter of fact Russia has been sending her sugar elsewhere for some years and has long since become quite independent of European markets.

These are the plain facts; but the public are asked to believe that the rise in sugar caused by the drought in the beetroot districts was really caused because Russian sugar, which has naturally ceased to come in this direction, is now penalized by the Convention. This fallacy, or misrepresentation, or creation of a diseased imagination, is developed in every way in which variations on the original air can be played, but enough has been said to make truth prevail.

Then it is urged that the drought, which caused a reduction in supplies of more than a million tons, was a mere flea-bite compared to the reduced sowings in 1904, in causing the rise in price. Here are the "greatly reduced" sowings for 1904 of the two principal countries, Germany and Austria:—

	Hectares. 1904.	Hectares. 1903.
Bohemia	132,300	125,600
Moravia	98,300	95,200
Hungary	91,500	88,300
Germany	416,700	416,000
Totals—1904	738,800	725,100
1903	725,100	
Increase 1904	13,700	

The French figures show a decrease, but as the information is only from 222 factories out of a total of 291 factories, they are not of much value. In any case, if there were a slight decrease for the whole of Europe it would be inappreciable, and yet it is given as "the real cause" of the rise in price. Curiously enough the crop of 1903, the sugar from which would come to market after bounties had been abolished, was an increase on the previous crop. The Convention, therefore, did not bring with it decreased sowings.

So far it has been shown that the statements of the opponents of the Convention are not only erroneous but directly contrary to the facts. There are many other wild assertions which are equally sensational but all untrue. Then come statistics, which in every case support the truth and refute the errors. For instance, the world's production of sugar is correctly given as follows, from Willett & Gray's circular:—

	Total. Cane and Beet. Tons.	Carried forward from previous year. Tons.
1901-2	10,798,733	921,562
1902-3	9,920,661	1,888,312
1903-4	10,303,498	1,879,031
1904-5	9,481,736	1,434,532
1905-6 (estimate)	11,728,000	1,391,000

It is easy to calculate from these figures the yearly consumption of sugar in the world—more than 10,000,000 tons. If, at the most, 200,000 tons of this total is compelled to find some other market outside the Contracting States, how can it possibly be contended by any sane person that the diversion of that infinitesimal fraction to other markets can possibly affect the circulation, or distribution, or price of the 10,000,000 tons, in round numbers, that remain free to go where they like? It is trifling with the common sense of the public to put forward such a fallacious—if not intentionally misleading—assertion.

Then we are given the monthly prices for 1903-4-5, which usefully illustrate our facts :—

Monthly Average Price per Cwt. of 88% Raw Beetroot Sugar, f.o.b. Hamburg.

	1903.		1904.		1905.	
January ..	8/1½		8/0		16/0	Crop Estimates confirmed.
February. ..	7/11¼		7/8¼	Slight shortage in Cuba.	15/4½	
March.. ..	8/4¼		8/3		14/3	Reduced Consumption.
April	8/3		8/5½	Drought began in Europe.	13/1½	
May	8/5¼		9/3		12/1½	Liquidation of speculative accounts.
June..	7/10½		9/1½		11/10½	
July	8/0		9/8¼	Growing period.	10/10½	
August	8/6	Convention came into force.	10/6¾		9/3	
September ..	8/6¾		10/7½		8/7½	
October	8/5¼		10/9¾	Crop period.	8/4½	
November ..	8/3		14/0		8/4	
December ..	8/3½		14/3¾			

No figures could possibly illustrate more clearly the real cause of the rise and fall. It will be observed that the abolition of bounties had no effect on prices, which dropped gradually from 8s. 6¾d. in September, 1903, the month of abolition, to 7s. 8¼d. in February, 1904, when a rally to 8s. 3d. in March, 8s. 5½d. in April, and 9s. 3d. in May, took place owing to the premature ending of the Cuba crop by the wet season setting in early. Then came signs of excessively dry weather in the beetroot districts, which caused manufacturers to buy back their forward sales. This forced prices up to 9s. 8¼d. in July. The drought then became fairly pronounced, and speculators entered the market. When actual estimates of the crop came forward in November and December, and it was found that there would be a shortage of something like a million tons, speculation became rampant, and prices were forced up to 14s. 3¾d. on the average for December, and 16s. in January. In the spring of 1905 it became evident that visible consumption was falling off owing to the higher prices. In other words, consumers were living on their invisible supplies as long as possible. At the same time the large bull account for May had to be liquidated, which caused a severe slump. Many speculative accounts were carried forward to August, which again had to be liquidated, so that when September came we were down again to 8s. 7½d., and visible supplies, instead of being reduced to nearly zero, were quite sufficient, owing to reduced consumption and living on invisible stocks, to carry over to the new crop, which, by its enormous size, had given the final death blow to the speculation.

Bounties have made us the slaves of the beetroot crop. Hence these tears. When the Convention has had time to release us from this bondage we shall enjoy that "freedom" which, as the writer of the pamphlet in his concluding paragraph so eloquently says, "is the first and greatest need." It is a pity that his obstinate obliquity of vision fails to see that it is exactly this freedom which was the object of those who entered into the Sugar Convention.

Some day he will discover that that freedom has at last been secured. If those so-called Free Traders—even of the Unionist party—would only consent to see straight in this matter things would be made much easier for Mr. Balfour in the coming contest. He has restored Free Trade to the sugar industry and wants to do the same in other quarters whenever necessary; but even among his own supporters there are some so priest-ridden by the erroneous dogma of "duty for revenue purposes only" that he has much difficulty in making the truth prevail. But it will.

GEORGE MARTINEAU.

LORD RITCHIE OF DUNDEE.

The translation of Mr. Ritchie to the Upper House affords a suitable opportunity for recalling the important part he took in former days in promoting the abolition of the sugar bounties.

It was in 1874 that he supplanted Mr. Ayrton in the representation of the Tower Hamlets, the sugar refining district of London at that time. The British Sugar Refiners' Committee were not long in discovering his ability, and he was equally quick in appreciating the opportunity of showing his metal. The subject at that time bristled with technical difficulties and diplomatic complications, while the economic aspect of the question was only just beginning to be clearly defined. It was necessary that the new member should be fully coached on all points, and he learnt his lesson with great accuracy and rapidity. When that was accomplished he entered into the controversy with spirit, and gave much assistance with sound advice and ready help. His speeches on the subject show how thoroughly he mastered the economic side of the question and how clearly he demonstrated that as bounties destroy free trade in our own markets their removal is necessary on free trade grounds.

He pushed the question so persistently, and demonstrated his case so clearly, that at last the Government were induced to refer the whole matter to a select Committee of the House of Commons, and Mr. Ritchie naturally became its Chairman. This gave him wider scope for showing his great ability, and no doubt Mr. Balfour, a member of the Committee, was not slow in his appreciation. The Committee sat for two sessions, and made a most exhaustive investigation of all the facts connected with the sugar industries, the diplomatic negotiations, the technical difficulties, and the economic aspect of the question. Mr. Ritchie's examination and cross-examination of the witnesses showed his complete grasp of a difficult subject, and his great capacity for bringing out the truth and sifting the grain from the chaff. The report of the Committee was a valuable contribution to economic science, and will eventually be released from its obscurity, and referred to as an authority of no little bearing on the great question of the day.

Thus did Mr. Ritchie start on his successful career, which has now been fitly consummated with the well-earned honour of a peerage.

ERRORS IN THE POLARIMETRIC DETERMINATION OF SUCROSE.

Although certain sources of error are still being investigated, sufficient material has accumulated to warrant a resumé of the results obtained by different workers in this important line of research The opinions of experts are given verbatim where possible, and numerous references made to the volumes of this Journal where the original papers, or translations of same, may be consulted. Some attempt is made to arrange the subject matter in logical order, and to render it intelligible to the general reader.

1. Errors in Preparing the Solution for Examination.

(a) *Due to the Composition of the Precipitate.*

As far back as 1871, Gill pointed out that levulose is precipitated by sub-acetate of lead in the form of levulosate of lead. In the presence of optically inactive reducing sugars, the effect of clarifying with an excess of sub-acetate of lead is therefore to render the dextrose active, and thus to over-estimate the proportion of sucrose. Gill recommended that samples of juice, &c., preserved by the addition of an excess of the sub-acetate, should be slightly acidified with acetic acid before filtration ; the result being the same as though the neutral acetate were employed in place of the basic salt.

Some instructive experiments by Hartmann (Vol. V., No. 59, p. 540) indicate that this error is quite as large as that due to the volume of the precipitate, when testing materials containing large percentages of invert sugar. His experiments appear to prove that neither the neutral nor the sub-acetate of lead can be relied upon for clarifying such impure solutions; the direct polarization of which only yields comparative results. For ascertaining the true percentage of sucrose in molasses and similar low-grade products, he recommends Clerget's method after clarification with neutral acetate of lead.

This conclusion has been recently confirmed by Messrs. Pellet (Vol. VII, No. 83, p. 531) in the following words:—"The only logical alternative, which will avoid disagreement in the analytical results of the same sample of raw sugar, is to determine the polarization by means of Clerget's process."

(*b*) *Due to the Volume of the Precipitate.*

As distinct from the chemical action of the clarifying agent, referred to above, this error arises from the fact that the precipitated solid matters occupy a portion of the measured volume of the solution. Numerous methods of correcting this error have been proposed from time to time.

The optical methods, due to *Scheibler* and *Sachs* (Vol. V., No. 56, pp. 376, 378), have proved quite unreliable.

Wiechmann's method (Vol. V., No. 56, p. 379).—The washed precipitate is dried to constant weight, and its specific gravity ascertained by weighing in benzine, from which data its volume V is calculated. Then, if $B =$ polarization of a sugar solution containing V cc. of precipitate, the corrected polarization $= \frac{100\,B - BV.}{100}$ Applying his method to various classes of raw sugar, Wiechmann found that "the observed error caused by the presence of the lead precipitate ranges from 0·05° to 0·98° Ventzke."

Hartmann (Vol. V., No. 59, p. 540) adopts the following:—Two solutions of the normal weight are prepared, solution A being clarified by double the quantity of lead solution added to B. Assuming that the quantity of precipitate produced in A is double that produced in B, and of the same composition, the corrected polarization is:—Pol. of A — (pol. of B — pol. of A).

Horne (Vol. VI., No. 61, p. 31) attempts to eliminate the error by clarifying with dry sub-acetate of lead after the true volume of the solution has has been adjusted. The author thus sought to dissolve the sugar in exactly 100 cc. of solution, leaving the lead precipitate to "occupy space exterior to that solution." He admits that "there is a slight concentration of the solution" by his method, but that "means of eliminating this small residual error are under investigation." The dry sub-acetate employed in his experiments contained 72·76% of lead.

Watts & Tempany (Vol. VII., No. 80, p. 395) employ a modification of Wiechmann's method. The sugar solution is clarified with sub-acetate of lead and diluted in a specific gravity flask of known water-content. "The flask with its contents is weighed, after which the solution is filtered off and its specific gravity accurately taken. The precipitate is washed with water till free from sugar, dried at 100° C, and weighed. From these data the volume of liquid displaced by the lead precipitate is readily calculated." Let $A =$ weight of solution plus precipitate. B = weight of dry precipitate. C = weight of solution which fills the flask when no precipitate is present. S = specific gravity of solution $\frac{30^\circ \text{C}}{30^\circ \text{C}}$. Then $C-(A-B)=W$ or weight of solution displaced. And $\frac{W}{S}$ = volume (cc.).

Messrs. Watts & Tempany find that their correction gives results agreeing closely with those obtained directly by Horne's method, from which they conclude that "Horne's method is a distinct advance in the direction of accuracy, while its simplicity will recommend it to all workers."

Messrs. Pellet (Vol. VII., No. 83, p. 529) do not consider that Horne's method is less subject to error than the older methods. "First, because of the possible presence of moisture; second, because it is difficult to avoid adding an excess of the reagent; and third, because only a portion of the lead salt is active, the other portion passing into solution, thereby increasing its volume and thus diminishing the polarization."

Criticising the method adopted by Watts & Tempany, they remark that the lead precipitate carries down an appreciable quantity of sucrose, thereby neutralizing any concentration due to displacement. They therefore think that "for raw cane and beet sugars, there is no need to correct the polarization for the possible influence of the lead precipitate."

Their own method of ascertaining the correction is to carefully wash a large quantity of the lead precipitate, and to decompose this by means of sulphuretted hydrogen. The lead sulphide is filtered off and the filtrate (containing the organic matters) concentrated by evaporation. A known weight of the filtrate is then added to a pure sugar solution in such proportion that, when re-precipitated with sub-acetate of lead, the volume of the precipitate formed corresponds to that obtained in the case of raw juice, sugar. &c. By thus ascertaining the polarizations of the same sugar solution, (*a*) in the absence of a precipitate, and (*b*) when the precipitate is included, it was found that the influence of the precipitate was appreciable but less than that indicated by calculating the volume occupied by the precipitate from its weight and density.

In replying to Messrs. Pellet's criticisms, Dr. Horne has since stated (Vol. VII., No. 84, p. 361) that "it is true that certain objections may be raised to the use of lead salts in general, but so long as nothing better can be found lead salts will be used, and I advocate the use of anhydrous sub-acetate of lead as an improvement upon the solution."

(c) *Due to Evaporation during Filtration.*

This error may be reduced to a minimum by employing a funnel with ground-edge and covering same with a ground-glass plate. The funnel should rest directly in the mouth of the receiving vessel.

Even where these precautions are taken, evaporation is not entirely prevented. Landolt quotes an experiment in which 50 cc. of a liquid were filtered in three minutes at an air temperature of 24·5° C. Although the filtering apparatus was carefully covered, the loss of water by evaporation represented an increase of 0·005% of the dissolved solid matter. Although such an error is too minute to affect the accuracy of technical analyses, it cannot be neglected in certain investigations.

2. THE INFLUENCE OF TEMPERATURE.

(a) *On the Concentration of the Solution tested.*

Since the quantity of optically active material contained in a unit volume, varies with the expansion and contraction of the liquid, it is essential that the solution be prepared and polarized at one and the same temperature. The *International Commission for Uniform Methods of Sugar Analysis* recommend a temperature of 20° C. at which all polarimeters should be adjusted, and all observations made. Where climatic conditions render this standard temperature inconvenient, any other temperature may be adopted, provided that the solution is prepared and polarized at the same temperature. As it is rarely possible to polarize solutions at exactly the same temperature at which they were prepared, a correction of ± ·034 per degree C. is applied; *plus* when the readings are made at a higher temperature, and *minus* when at a lower temperature.

(b) *On the Polarimeter.*

Variations from the standard temperature at which the polarimeter was adjusted have a three-fold effect. First, on the length of the observation tube, and consequently on the depth of liquid examined; second, on the strength and density of the solution; and third, on the optical activity of quartz in the case of the compensation-type of instrument. These three errors of the Schmidt and Haensch instruments are simultaneously corrected by Jobin's formula :—

$$\text{Polarization} \pm (\cdot 00016t)\ N$$

where t is the difference of temperature of observation from that at which the instrument was standardized and N is the observed polarization. The correction being *plus* for temperature above, and *minus* for temperature below that of which the instrument was standardized.

(c) *On the optical activity of sucrose.*

The recommendation of the *International Commission*, referred to under (*a*), assumes that, at different temperatures, the *same weight* of sugar dissolved in the *same volume* will give identical polarimetric readings when correction is made for the influence of temperature on the optical apparatus.

Since 1846 various authorities have claimed that temperature also influences the optical activity of sucrose. The earlier experiments supporting this view have been severely criticized by Wiechmann (Vol. II., No. 21, p. 491) and do not call for futher remark.

A more serious attempt to prove this influence of temperature is that of *Watts & Tempany* (Vol. VII., No. 80, p. 391). These workers based their conclusions on the assumed purity of a specimen of "pure sucrose" prepared by Kahlbaum, two solutions of which gave corrected readings of 99·705 and 99·748 respectively. They conclude "that changes of temperature (up to about 30° C.) cause a lowering of the reading on the Ventzke scale which may be corrected by the formula:—

$$\text{Polarization} \pm (\cdot 0023t)N,$$

where t is the difference of temperature of observation from that at which the instrument was standardized, and N is the scale reading observed. Combining this with Jobin's correction for quartz, they recommend a total correction for temperature of $\pm$ $(\cdot 00039t)$ N.

Wiechmann (Vol. VII., No. 81, p. 421) throws doubt on the above results by questioning the purity of the sugar used by the investigators, pointing out the extreme difficulty of drying such specimens without causing slight decomposition, and also the risk of absorption of moisture from the atmosphere during the operation of weighing. The absolute purity of the dried sample should have been proved by preparing and polarizing a solution at the temperature (17·5° C.) at which the polarimeter had been standardized; or, failing this, to determine the sucrose by the gravimetric method with Fehling's solution.

Messrs. Pellet (Vol. VII., No. 83, p. 527), support Wiechmann's criticisms, although admitting that "the rotatory power of sucrose is slightly diminished by a rise in temperature." These authorities differ from Messrs. Watts & Tempany mainly as regards the correction to be applied; and they propose to study the problem by the aid of more sensitive polarimeters, giving readings to $\frac{1}{20}$th of a degree of the scale.

We understand that Messrs. Watts & Tempany are also following up their experiments, but their replies to Messrs. Pellet & Wiechmann have not yet appeared.

3. ERRORS OF THE INSTRUMENT.

Apart from the influence of temperature, the possibility of defects in construction renders it necessary to test the accuracy of the polarimeter and measure flasks before use. This work is undertaken by the Reichanstalt, Charlottenberg, on payment of a fee but, as no special apparatus is essential, all instruments should be tested by those who use them.

4. ERRORS OF OBSERVATION.

Three sources of error come under this head.

(a) *Error of a Single Observer.*

Consecutive polarimetric readings of the same solution are rarely identical, even when made by an experienced observer. Hence, where any degree of accuracy is essential, the mean value of several readings must be found. The latter is itself only an approximation to the true value sought; the approximation, being closer in proportion as the difference between the extreme readings is small, and as the number of readings is large.

(*b*) *Differences between two or more Observers.*

These are more often met with in the case of colour-polarimeters than with shadow-instruments. Assuming that such differences refer to mean values, and not to single readings, they are due to "personal equation" and will re-appear at all points of the scale. This kind of error is eliminated by increasing or diminishing each observer's readings by their respective zero-readings.

(*c*) *Error due to the Limitation of the Instrument.*

The instrument usually employed for sugar work is designed to measure to the tenth of one per cent. Although this degree of accuracy suffices for commercial analyses, it renders the optical method of sugar analysis distinctly inferior to gravimetric methods. The mean value of several polarimetric readings can, of course, be expressed to several decimal places; and, if the readings are fairly concordant, some degree of confidence can be placed on the second decimal. Modern instruments are being constructed which give readings to the twentieth of a Ventzke degree.

REMARKS.

Where experts disagree, who shall decide? One subject of dispute may be dismissed in a few words. The influence of temperature on the optical activity of sucrose is a question to be decided by experimental evidence alone. Experts do not express opinions regarding *probabilities*, but regarding the nature of the evidence brought forward. Where many experimental difficulties exist, criticism is of the greatest value in avoiding errors, and thus ultimately arriving at the truth. We must hope that the investigations now in progress will furnish more definite information regarding this supposed influence of temperature.

In the practical applications of the polarimeter, advantage has been taken of the fact that errors in opposite directions tend to neutralize each other. In cases where extreme accuracy is not essential, this course has the advantage of simplicity, but in very few cases does it yield accurate results. In order that two such errors may cancel each other, it must not only be shown that their opposite effects are approximately equal, but that the two errors are *constant*.

Neglect of this latter condition appears to account for the difference of opinion as to the necessity of correcting for the volume of the lead precipitate. This error is a *variable* one, being due to the organic impurities present in the material treated, whereas the error which is supposed to cancel it, namely, the influence of temperature on the quartz-wedge compensatòr, remains *constant* in any given locality. The probability of these two errors being equal is, therefore, extremely remote.

We think that a clearer distinction between constant and variable errors would lead to a more rational method of attacking the difficulties of polarimetric analysis. Like most analytical methods, the polarimetric determination of sucrose demands certain conditions for its successful application. This leads us to distinguish between the polarimetric *method* (*i.e.*, the actual measurement of optical rotation) and the *applications of the method* (in the analysis of raw saccharine products).

The errors of the *method* include those due to the instrument used, to the influence of the local temperature, and to the "personal equation" of the observer. These errors being constant, their removal should constitute the first step towards ascertaining what further corrections may be necessary when the method is applied to the analysis of various materials.

From our present point of view, the polarimetric method is perfect when a normal-weight-solution of pure sucrose (or its optical equivalent) gives correct readings on the scale. Consequently, the errors of the method may be eliminated by adopting a corrected normal weight for each instrument when used at a certain mean temperature. We understand that Professor Harrison was the first to adopt this plan, which, at the same time, corrects for any local influence of temperature on the optical activity of sucrose.

On turning from the *method* to its practical application we meet with relatively large errors of an entirely different nature, as enumerated in the first part of our resumé. Since these errors vary with the purity of the material tested, they cannot be eliminated by rules of general application. The question whether a correction should be applied for the volume of the lead precipitate then becomes a question of the relative purity of the material under examination since the organic non-sugars are the sole cause of the error in question. Dr. Horne's method of "dry clarification" appears to reduce this error to a minimum.

It is somewhat strange to record that the most serious of all polarimetric errors has received the least attention on the part of investigators; we refer, of course, to the indirect action of the basic and neutral acetates of lead on the optical activity of saccharine solutions containing invert sugars. The selection of a more suitable clarifying agent should not be impossible, and is most urgently needed in order to minimize the unknown errors of chemical control in the factory. In the meantime, the only alternative is to adopt Clerget's modification as the *standard method* and to apply an approximate correction to the direct polarization as ascertained from comparative analysis of typical products of the sugar factory.

DRY DEFECATION IN THE ANALYSIS OF SUGARS.

By H. and L. PELLET.

Regarding Dr. W. D. Horne's comments on our recent note on this subject, we would make the following remarks:—

1. We think that the sub-acetate of lead might be replaced by the neutral acetate with several advantages. The latter gives less precipitate and does not influence the polarization to the same extent as the sub-acetate. On the other hand, it is true that it does not decolourize so efficiently, but this disadvantage is inconsiderable in the case of saccharimeters of modern construction, with electric attachment, giving a strongly illuminated field, and thus rendering it easy to polarize solutions which are coloured, even when these are prepared from molasses.

2. We are aware that the so-called dry sub-acetate of lead, as manufactured by Messrs. Baker and Adamson, of Easton, is a compound of uniform composition, very soluble, and possessing as great a decolourizing power as the liquid sub-acetate of lead, of equal density. It is, therefore, equally applicable in the beet sucrerie, since solutions of this product, of any required density, can be rapidly prepared.

3. Dr. Horne finds that the lead precipitate entrains a certain quantity of sugar, but that this quantity is so small that its influence on the polarization is inappreciable. We think, however, that the method adopted by our colleague is not entirely conclusive. The precipitate produced by the sub-acetate of lead does, in fact, carry down an appreciable quantity of sugar. It remains to be seen whether this entrained sugar can be completely removed from the precipitate by washing with an excess of water.

In a note entitled "Applications of the picnometric method to the determination of the weight and volume of precipitates suspended in liquids,"* MM. H. Gillet and A. Grosjean mention that certain precipitates entrain relatively large quantities of sugar. We await their results as regards the lead precipitate which they propose to study anew, in order to ascertain the quantity of sugar retained by this precipitate when formed in saccharine solutions of different purities.

4. On our part, we propose repeating certain comparative tests with cane sugars of different purities, treated with the sub-acetate of lead, the neutral acetate, and chloride of lime, which latter is a very efficient decolourizer in the case of cane products. The results we shall publish will be obtained by working with a most sensitive saccharimeter of the latest construction.

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* Bulletin de la Societé Chimique de Belgique, No. 7, Tome XIX., Juillet, 1905.

SIMPLE METHODS OF CHEMICAL CONTROL.

By T. H. P. Heriot, F.C.S.

(Continued from page 572.)

VII.

The Optical Test.—(*Continued.*)

As in a former chapter, we must here assume that the instrument now to be described is in the reader's hands. The first step is to unpack the polariscope and put it into working trim. The lower extremity of the brass pillar is to be screwed to the tripod base, and the upper extremity of same screwed into the socket provided for it on the body of the polariscope. The latter is thus supported horizontally as shown in *Fig. 18*.

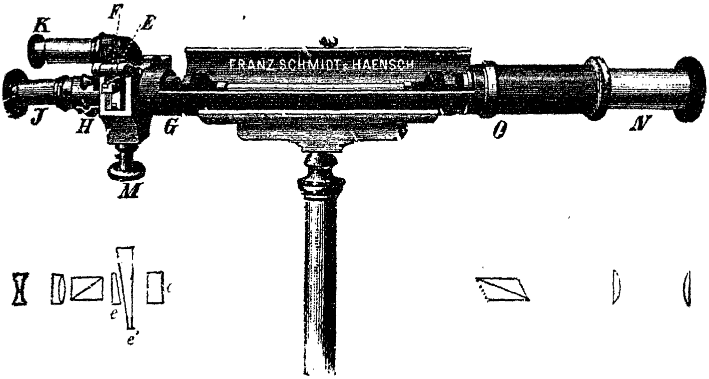

Fig. 18.

The magnifier (*K*) is then attached in the position shown by means of two screws immediately over the letter (*H*). The instrument is to be placed on the table prepared for its use, as described in Chapter II., so that the eye-piece (*J*) is immediately above that end of the table at which the observer sits. The lamp is next lighted and placed at the opposite end of the table, in such a position that the metal chimney is not less than six inches distant from the extremity (*N*) of the polariscope, and the flame exactly in line with the horizontal axis of the instrument.

As thus arranged, a horizontal ray of light from the lamp enters the polariscope at (*N*) and passes successively through the polarizing crystal at (*O*), the observation tube (shown in position, with the cover raised), the compensating apparatus (*F*, *E*, *G*), the analyzing crystal (*H*), and eye-piece (*J*). The optical parts of the instrument are shown separately in the lower part of the figure, but these do not call for particular description.

The object of the movable quartz-wedge (*é*) was explained in the last chapter, but a clearer idea of its action may be gained by inspecting it. To this end, turn the screw (*M*) in either direction until the brass frame (containing the wedge) slides into its extreme position. If the projecting part of the frame be now securely held, the frame can be withdrawn from the instrument by gently pulling it in the same direction as it had been previously moved by the screw (*M*).

From the position of the wedge in its frame, it will be evident that the ray of light passing from (*N*) to (*J*) must penetrate different thicknesses of quartz for different positions of the wedge as controlled by the screw (*M*).

A finely graduated scale is attached to the top of the frame; the divisions of the scale bearing a direct relation to the thickness of the wedge at corresponding points. This relation might otherwise be lost sight of because the numbers on the scale represent percentages of sugar in the liquid tested.

The wedge must now be replaced by inserting the end of the frame in its guides and pushing it forward gently until it can be moved by the screw (*M*). The greatest care must be taken not to damage the instrument whilst removing and replacing the frame.

The optical effect produced by any given thickness of the quartz-wedge is visible through the eye-piece (*J*); whereas the corresponding mark on the scale is ascertained by means of the magnifier (*K*). These two observations must now be described in some detail.

The optical effect.—It is a familiar fact that slight differences of colour can only be detected when the colours to be compared are simultaneously visible. The same holds true when different intensities of light have to be observed as in the polariscope, and the remarkable power of the eye to detect such differences is ingeniously utilized in the construction of this instrument. When the eye-piece (*J*) is properly focussed, the *field of vision* appears as a disc of light, one half of which is more or less shaded. If the quartz-wedge be moved in one direction (by turning *M*), the unequal illumination of the *field* increases; if moved in the reverse direction, the *field* becomes more uniform, until it finally assumes the appearance of a uniformly lighted disc, divided centrally by a fine vertical line. The focus of the eye-piece (*J*) must be adjusted until the dividing line is clearly visible. This uniform appearance of the *field* informs the observer when the quartz-wedge has been moved into a position in which all optical activity is neutralized. The appearance is disturbed by the slightest turn of the screw (*M*), although the motion thus communicated to the quartz-wedge-frame cannot be detected by the eye. Hence, the sensitiveness of the polariscope as a measuring instrument depends on the ease with which the exact position of the wedge can be adjusted by the aid of the trained eye.

A practical note must be inserted here. If the illumination of the *field* does not become perfectly uniform, as described above, this may be due to the lamp being out of line with the polariscope. The latter can be turned from side to side owing to the screw-connection with the upright pillar, and it is therefore always necessary to point the polariscope body towards the bull's eye of the lamp. But the height of the lamp may be at fault, and in order to detect this, the field should be viewed through (J) while an assistant raises or lowers the body of the lamp, after slackening the screw near its base. When the correct height has been found, this screw is tightened up.

Reading the scale.—On focussing the magnifier (K), some portion of the scale will appear as in *Fig. 19*, and other portions may be brought into view by suitably turning the screw (M). The scale will then be seen to move above a short, fixed scale, the central point of which (marked zero) lies above the optical axis of the polariscope. That point on the movable scale which coincides with this fixed point, is called *the reading* or the measurement obtained. In *Fig. 19*, the fixed zero lies between 30 and 31 of the scale, and we have now to explain how a more exact measurement can be made by the use of the fixed scale or "Vernier."

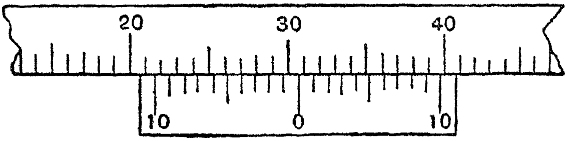

Fig. 19.

The divisions on the latter are smaller than those on the scale; ten of the former corresponding to nine of the latter. Consequently, when the 30-line on the scale coincides exactly with the zero-line on the Vernier, the tenth line to the right of zero coincides with line 39, while the intermediate lines (1 to 9) do not coincide with any lines on the scale. In passing from this position to that represented in *Fig. 19*, the Vernier-lines 1 to 7 are *in turn* brought opposite certain lines on the scale. On moving the scale further still, the same occurs to the Vernier-lines 8, 9 and 10. But during these ten *successive* movements the Vernier-zero has only passed from line 30 to line 31 of the scale, so that this unit has been measured in ten sub-units, or tenths. The correct reading represented in *Fig. 19* is, therefore, 30 plus seven-tenths, or 30·7, because the Vernier-zero is beyond the line 30, and the seventh line to the right of zero coincides with a line on the scale.

The reading of the scale is much less complicated than may appear from our written instructions, but the following general rules will be found applicable to all points on the scale except the zero-point.

(*a*) If the vernier-zero exactly coincides with a line on the scale, record the number of that line as the correct reading (a whole number).

(*b*) In all other cases record (as the whole number) the scale line which lies to the left of the vernier-zero. Then observe which vernier-line (from 1 to 9) *to the right of zero* coincides with a line on the scale, record this as *the tenths* and add same to the whole number already found.

Filling the Observation Tube.—Two glass tubes will be found in the polariscope case; one being 200 millimetres in length, the other 100 millimetres. An additional 200 mm. tube* of metal, will answer our present purposes, so the two glass tubes, together with the spare cover-glasses and rubber washers, may be left in the polariscope case.

Unscrew the caps from the ends of the metal tube, and polish the cover-glasses with a soft cloth. Inside each cap is a rubber washer which need not be removed, and must never be omitted. Replace one cover-glass and cap, screwing on the latter until it ceases to move freely. A *slight* additional turn of the cap will then ensure perfect contact between the cover-glass and the flat end of the tube. Now stand the tube upright on its capped end and fill it completely with clear rain-water, so that the liquid surface rises slightly above the flat end of the tube. Holding the second cover-glass horizontally by its edges, slide same into its position on the top of the tube without leaving any air-bubbles beneath the glass and without wetting the upper surface of same. The former occurs when there is not sufficient water; the latter when there is too much; the happy medium must be found by actual trial. Finally, the second cap is screwed "home" gently, and the exterior of the tube wiped dry. The two cover-glasses now confine a column of liquid of exactly the same length as the tube.

The above instructions are to be followed when filling the tube with clarified juice, sugar solutions, etc., always bearing in mind the following points:—

1. The cover-glasses must not be scratched or chipped. They should be polished immediately before use.
2. The rubber washers should be examined occasionally and replaced by new ones when they become hard and brittle.
3. The interior of the caps should be wiped before use, thus removing the surplus moisture from the enclosed washers. The caps must on no account be screwed tightly on to the tube.
4. If more than one solution is to be examined in the *same* tube, this must be rinsed out several times with each solution before being filled.

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* Specified in list of apparatus, chapter 3.

5. It being important that the tube and its contents should have the same temperature as the polariscope, care should be taken not to handle the tubes more than is absolutely necessary.

Adjusting the Zero-point.—The observation tube, filled with pure water, is now to be placed in position on the polariscope and covered by the hinged flap. The eye-piece (J) must again be focussed and the screw (M) manipulated until both sides of the *field* are equally illuminated and the dividing line sharply defined. Raising the eye to the magnifier (K), the zero-line of the scale should coincide with the zero-line of the fixed vernier, there being no sugar in the observation tube.

But, even if it does not, the exact reading is ascertained by the rules given above. If the vernier-zero lies to the left of the scale-zero, this indicates a *minus quantity*, and in this case the vernier-lines *to the left* of the zero represent the tenths. If, for example, the vernier-zero lies between the scale-zero and the next scale-line to the left, ascertain which line on the left-hand side of the vernier coincides with same line on the scale. Assuming the third line of the vernier to be in this position, the correct reading would be — 0·3 (all readings to the right of the scale-zero being *plus* quantities).

Whatever be the reading found, a single observation cannot be relied upon even in the case of an experienced observer. The amateur must, therefore, make sure of his ground by repeating the observation until he has recorded ten readings. After each reading of the scale has been noted down, the screw (M) is given a half turn in order to disturb the neutral appearance of the field, which must then be restored as accurately as possible before the next reading of the scale is taken. Finally, add up the *plus* readings separately from the *minus* readings. Subtract the smaller total from the greater, and the remainder, divided by ten, will represent the mean value of the ten observations. Even this result is only approximately correct, because the actual readings will probably differ too much from each other. The observer must not, on this account ignore readings which appear to be faulty. Accuracy will come with practice, and the progress made will soon be apparent if all observations of the zero-point are recorded and dated.

The mean value of ten readings may be accepted as sufficiently accurate when the two extreme readings do not differ by more than 4 divisions of the vernier (for example, + 0·2 and — 0·2; +0·3 and — 0·1; 0·0 and + 0·4). If this mean value is exactly zero, the instrument requires no adjustment.

Let us, however, assume a mean value of — 0·2. Adjust the screw (M) so as to obtain this reading on the scale, when the quartz-wedge will, of course, be in its true position, giving a perfectly uniform illumination of the *field*. The small key provided with the instrument is now inserted in the socket near the quartz-wedge frame and on the observer's *left*. On viewing the scale through (*K*) whilst turning the key, it will be seen that the vernier is thus moved while the scale is stationary, and the key must be turned in which ever direction will bring the vernier-zero into exact coincidence with the scale-zero. This being done, and the key removed, the screw (*M*) is given a half-turn and another series of observations made. If the mean value before adjustment was accurate, the mean value after adjustment should be exactly zero.

We do not advise the amateur to attempt this operation until he has had several weeks of practice with the instrument. Each day the observation tube should be filled with water and the mean of ten readings taken as the "zero-reading." All readings of sugar solutions being corrected by deducting the "zero-reading" when this is *positive*, and adding it when it is *negative*. As the observer's eye becomes trained to the work, his daily "zero-reading" will become more and more constant.

When two or more observers use the same instrument, it does not follow that they will obtain the same reading at the zero or any other point of the scale. Slight differences of eye-sight introduce what is known as the "personal equation." But this difference being a constant one, it is eliminated when each observer corrects his readings of sugar solutions by his own reading at the zero-point of the scale.

The hundred-point of the scale.—Having now set the polariscope in proper working order, attention must be directed to the other limit of the scale, marked 100, and which corresponds to the thick end of the wedge.

As sucrose is optically active only when in a state of solution, polariscope makers have to adopt a solution of standard strength when graduating their instruments. The "Ventzke Scale" of our polariscope is based on the optical activity of a solution of pure sucrose of a certain density, when examined in a 200 m.m. tube. That position of the quartz-wedge which exactly neutralizes the optical activity ot the solution is then marked 100 on the scale. The taper of the wedge being uniform, it only remains to divide the space lying between the zero and the 100 mark into 100 equal parts.

But, although the Ventzke scale is still adopted, the author's method of fixing the strength of the solution has been abandoned; if being more convenient to dissolve a known weight of substance in a known volume, than to ascertain the exact density of the resulting solution. The density selected by Ventzke corresponds to a solution containing 26·048 grams of sucrose in 100 cubic centimetres. To minimize the inconvenience of this odd weight, special weights are supplied with the instrument; one, the "normal weight" having the above value; the other, or "half-normal weight" of 13·024 grams.

The standard solution is prepared by dissolving the normal weight of absolutely pure sucrose in sufficient water to give precisely 100 cc.

of solution. When a column of this solution, 200 mm. in length, is examined in the polarimeter, the uniform illumination of the *field* is only secured by moving the quartz-wedge into its maximum position, which corresponds to the 100 point of the attached scale.

It is thus possible to convince oneself that the quartz-wedge has been constructed of the proper dimensions, and also that the two extreme positions of the wedge are accurately indicated by the scale, but many minute precautions are necessary before the skill of the instrument maker can be called in question. We shall presently describe a much simpler method of testing the accuracy of the instrument, but if the standard solution be also prepared and examined the amateur will have a clearer idea of the relation between the normal weight and the graduations of the scale.

In chapter three, full directions were given for preparing a 20% solution, so that it is only necessary to substitute the *normal polariscope weight* for the 20 gram weight then used, and to work with pure sucrose* instead of with raw sugar, As such a pure solution does not require to be clarified with sub-acetate of lead, the contents of the measure flask have merely to be diluted exactly to the 100 cc. mark and then thoroughly mixed by inverting the closed flash several times. The *dry* observation tube is filled as before and placed in position on the polariscope.

Should the screw (*M*) have remained untouched since the zero-point was adjusted, the illumination of the two halves of the *field* (as seen through (*J*)) will now be strongly contrasted; this change being, of course, due to the optical activity of the sugar solution. The uniform illumination of the *field* has now to be restored by bringing the quartz-wedge into play and several complete revolutions of the screw (*M*) will be necessary before the two halves of the optical field again appear equally bright. This having been done, the reading should be approximately 100, but the mean of several readings should be ascertained as in the case of zero-point. If this final result differs from 100, it is far more probable that the manipulations have been faulty than that the instrument is inaccurate.

The result obtained may, of course, be checked by weighing out another quantity of pure sucrose and repeating the manipulations more carefully. This should be done if only to assure one's self that the instrument is not *alone* at fault. All such results will probably fall short of the exact 100 because we have ignored the influence of temperature on the optical parts of the polariscope. Without entering into rather complicated details, it will be sufficient for our present purpose to assume that when every error is avoided the normal-weight-solution of pure sucrose would give a mean reading of 100·0 on the scale.

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* See list given in chapter 2.

If, then, we prepare a normal-weight-solution of any impure saccharine material and repeat the foregoing manipulations, we shall obtain a mean reading of the scale which expresses *the percentage of sucrose in the material tested*. That this desirable result is not obtained "by magic" should now be clear, for we have tested a substance containing 100% of sucrose and obtained a (corrected) reading of 100·0, whereas a liquid entirely free from sugar gives a reading of 0·0.

With ordinary care in using it, the polariscope is not likely to get out of order, even when in daily use. Should it receive any accidental knocks the optical parts may become displaced and the instrument rendered useless. Hence it is very desirable to check the readings of the instrument from time to time, both at the zero and at some other point of the scale. In the latter case the standard sugar solution may be conveniently replaced by what are known as "standard quartz plates." Having seen that the optical activity of the quartz-wedge is of an opposite, or negative, character to that of a solution of sugar, it is necessary to explain that these are two varieties of optically active quartz; one twisting the polarised ray *to the left* (the quartz-wedge) and the other twisting the ray *to the right* (the standard quartz plate). Standard plates of different thicknesses are constructed for testing different points on the scale, but a single plate giving a reading of 96 will be sufficient for our purpose. The plate is mounted at one end of a short metal tube which takes the place of the observation tube for liquids. It is worth noting that a comparatively thin plate of quartz has an optical activity equal to a sugar solution 200 mm. in thickness; also, that the *right-handed* optical activity of the standard quart plate is neutralized by an *equal thickness* of the *left-handed* quart-wedge when the latter is moved into the required position. Each standard plate is furnished with a printed table of corrections for temperature, with instructions for using same.

This chapter concludes our examination of some of the methods used in the laboratory. We have endeavoured to instruct the reader in the use of the chemical balance, the measure flask, the hydrometer and the polariscope. If the last two chapters have failed to interest the *practical man*, it is because our somewhat difficult task has been imperfectly performed. Those who have been unable to follow our *theoretical explanations* should therefore direct their attention exclusively to our *practical instructions*.

It is precisely at this stage of our enquiry that practice is of the utmost importance because, in the chapters which follow, we shall be occupied with special application of the methods already described. Samples of raw sugar of different qualities will form excellent material for practice, several solutions of the same sample being prepared and polarized until fairly concordant results are obtained. The density test may be practiced with samples of raw juice, but, as this liquid requires some preliminary purification, we recommend diluted syrup, commencing with one part of strong syrup to two parts of water, and then gradually increasing the dilution by mixing with small additions of water, observing the effects on the density test at each step. Not until our "science" is perfect can we attempt to apply it in the sugar factory.

(*To be continued.*)

THE CONSTITUTION OF JAVA CANE SUGAR MOLASSES.

By H. C. Prinsen Geerligs,

Director of the West Java Sugar Experiment Station at Pekalongan (Java).

A few years ago* I published in collaboration with Mr. E. Rose the results of an investigation of the exhausted molasses obtained during the 1899 season in a number of Java sugar factories; and I am now induced, by the great changes that have taken place during the last five years, to repeat the task as regards the actual molasses. The chief difference between the old and the new work in the factory consists herein, that formerly the exhausted molasses were obtained from after-products, which after being boiled string-proof were allowed to cool down during a few weeks in crystallizing tanks, while now a great number of factories have adopted the system of returning the molasses to the original masse-cuite, and boiling them together on grain, yielding, on direct centrifugalling from the vacuum pan, first sugar and exhausted molasses.

It is not improbable that this new method influences the character of the waste molasses, since in the latter case it is feasible to keep the masse-cuite more concentrated, the higher temperature in the vacuum pan allowing it to remain more liquid than in the cold crystallization tanks, so that more water may be evaporated and perhaps more sugar crystallize out without the molasses becoming too sticky to be properly cured.

In order to elucidate this particular point I divided the molasses under examination into two groups, viz., those obtained by centrifugalling first masse-cuites direct from the vacuum pan, and those

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***I.S.J.*, 1901, 515.

obtained from string-proof boiled after-products masse-cuites after being cooled in the tanks.

The data yielded by the analyses are recorded in the tables given further on, whilst a few particulars about the analytical methods will not be out of place here.

The exhausted molasses were analysed in the same state as they arrived, without taking the trouble to eliminate the minute particles of sugar crystals, which some of the samples contained; furthermore, the samples were all well stirred previous to examination with a view to making them homogenous. Next 100 grammes of the molasses were weighed in an Erlemeyer flask of suitable dimensions, diluted with 100 grammes of distilled water, the flask was shut with a cork and well shaken till complete dissolution was reached. In this solution I determined the specific gravity by means of a pycnometer and derived the corresponding figure for the degrees Brix. by using the well-known tables.* This figure multiplied by two and with the correction for the temperature added to it, yielded the degrees Brix. of the molasses at the temperature of 17·5° C.†

The same solution was used for the determination of the actual amount of dry substance. To this end I placed a sheet of filter paper in a Scheibler dish, dried both in the hot air bath, and weighed them after cooling. Next, I poured as much of the diluted molasses on the paper as the latter would absorb, weighed the dish again to ascertain the weight of the solution and dried in the air bath at a temperature not exceeding 105° C., and not falling below 100° C., till two consecutive weighings yielded the same figure.

26·048 grammes of the solution were weighed in the usual German silver dish for the polarization, poured into a 100 c.cm. flask, diluted with the washings of the dish, clarified with a quantity of basic acetate of lead, varying, according to the degrees Brix., from 15 till 20 c.cm., filtered, and polarized in the 200 mm. tube with acetylene light. The readings multiplied by two were then put down as the direct polarization.

50 c.cm. of that same clarified filtrate were inverted after Clerget's method with 5 or 6 c.cm. of hydrochloric acid of 38% in a 100 c.cm. flask on a water bath at a temperature of 68-70° C., and filled up to the mark after being cooled to the same temperature at which the direct polarization had been determined. The solution was decolourized as much as possible with a pinch of finely powdered, extracted bone-black, filtered and polarized at the same temperature in the 200 mm. tube. The readings multiplied by four gave the polarization after inversion, from which the actual percentage of

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* Prinsen Geerligs, Methods of Chemical Control, p. 50.

† Archief voor de Java Suikerindustrie, 1902, p. 1111.

saccharose, or polarization after Clerget, was derived by the formula

$$\text{Polarization after Clerget} = \frac{\text{POL. direct} - \text{POL. after inversion}}{142{\cdot}5 - \frac{1}{2}t}.$$

I determined the glucose by dissolving 10 grammes of molasses in a litre flask in about half a litre of water, clarifying with 15 c.cm. of a 10% solution of neutral acetate of lead, filling up to the mark, shaking and filtering. The filtrate was poured into a burette and used for the titration of 10 c.cm. of Fehling's test solution, thus corresponding to 50 milligrammes of glucose. The glucose content of the molasses could, therefore, be calculated by dividing the number of c.cm. necessary for the complete decolouration of the 10 c.cm. of test solution by 50.

The determination of the ash and its contents of gummy and nitrogenous matter was conducted after the same methods as already described in the *International Sugar Journal*, 1901, page 519, and do not require further description here.

From these figures I derived others by calculation in the following way: The apparent quotient of purity is the quotient of 100 × the direct polarization and the degrees Brix.

The real or true quotient of purity is the quotient of 100 × the figure for actual saccharose, or the polarization after Clerget, and the figure for the actual dry substance.

The rotatory power of the glucose is calculated by dividing 100 × the difference between direct polarization and polarization after Clerget by the figure for the glucose. This value is not quite exact, as in the polarization it is not the total amount of the glucose that is represented, owing to the property of *basic* acetate of lead of throwing down a part of the fructose (lævulose), which is not the case with the *neutral* acetate; so that in the estimation of the glucose the total amount of that constituent is determined, and therefore both figures may not be brought into relation. The difference is, however, inconsiderable and as fructose is lævo-rotatory, the calculated figure for the rotatory power, in which too little fructose is represented, is somewhat too high. As yet there does not exist a clarifying agent, capable of decolourizing, without trouble or affecting the polarization, the solution of such dark-coloured molasses, so that we have to content ourselves with the basic acetate of lead and the slightly erronous values it yields for the rotatory power of the glucose.

I.—MOLASSES CENTRIFUGALLED DIRECTLY FROM FIRST SUGAR MASSE-CUITES.

Number.	Method of Clarification.	Name of the Factory.	Quotient Original Juice.	Degrees Brix.	Actual dry substance.	Direct Polarization.	Polarization after Clerget.	Apparent Quotient.	Real Quotient.	Glucose.	Ash.	Gummy matter.	Organic Non-sugar.	Rotatory power of the Glucose.	Factor for the Ash for the difference between Brix and dry substance.	Saccharose dissolved in 100 parts of water.	Ratio between Glucose and Ash.	Difference in quotient (apparent) between Juice and Molasses.	Difference in quotient (real) between Juice and Molasses.
1	Carb.	Djatiwangi	..	84·56	80·43	32·6	34·42	38·55	42·79	22·13	7·61	0·86	16·22	— 8·2	0·53	125	2·91	..	..
2	,,	Kadhipaten..	89·2	82·10	78·60	32·2	31·93	39·22	40·62	21·74	7·26	0·51	17·67	+ 1·3	0 48	149	3·00	49·98	48·58
3	,,	Kadhipaten	86·5	81·84	77·60	28·6	28·15	34 95	36·15	25·00	7·45	0·59	17·00	+ 1·8	0·57	121	3·36	51·55	50·35
4	,,	Soerawinangon	..	86·78	82·18	28·8	30·6	33·19	37·24	22·00	10·80	0·89	18·78	— 8·2	0·47	172	2·25	..	..
5	Def.	Asembagoes	82·37	95·61	88·04	33·8	40·65	35·52	46·17	21·74	12·94	2·39	12 71	— 31·5	0·55	339	1·67	46·85	36·20
6	,,	Bogohkidoel..	..	86·42	80·98	29·4	34·1	39·53	42·11	23·2	8·88	2·36	14·80	— 20·3	0·60	179	2·62	..	..
7	,,	Kawarassan	82·43	87·39	82·48	32·8	36·52	37·53	44·28	23·25	8·02	1·72	10·59	— 16·0	0·61	209	2·90	44·90	38·15
8	,,	Kemantran, 1904 ..	90·3	85·64	77·64	30·4	37·65	35·56	48·50	17·24	9·23	2·57	13·52	— 42·1	0·87	168	1·87	54·74	41·89
9	,,	Kentjong	82·0	87·02	81·30	32·6	38·43	36·32	47·27	21·73	8·21	1·71	12·83	— 26·8	0·68	206	2·65	45·68	34·73
10	,,	Maron	85·1	91·92	85·41	31·1	35·8	33·83	41·92	24·6	10·45	1·22	14·56	— 19·1	0·62	244	2·35	51·27	43·18
11	,,	Minggiran	84·06	88·32	81·76	31·8	36·05	36·00	45·35	23·81	9·23	1·84	12 67	— 19·6	0·71	197	2·58	48·06	38·71
12	,,	Pandaän	85·3	92·56	87·70	33·2	39·0	35·86	44·47	29·4	8·00	2·01	11·23	— 19·7	0·61	317	3·67	49·44	40 83
13	,,	Poerwaosri	86·9	86·42	81·15	32·2	37·80	37·26	46·58	22·73	8·39	2·00	12·23	— 24·7	0·63	205	2·71	49 64	40·32
14	,,	Sedati	81·4	87·14	82·26	27·4	32·49	31·44	39·50	29·41	7·70	1·09	12·66	— 17·3	0·63	183	3·82	49·96	41·90
15	,,	Seloredjo	84·4	88·48	82·96	29·8	36·1	33·69	43·51	22·20	7·39	2·00	17·27	— 28·4	0·75	208	3·00	50·71	39·89
16	,,	Sragi	87·5	87·26	82·85	22·8	29·96	26·13	36·16	25·64	7·96	2·27	19·29	— 27·9	0·56	175	3·22	61·37	51·34
17	,,	Sroeni	85·8	89·37	83·94	39·2	42·44	43·86	50·56	21·28	9·06	1·51	11·16	— 15·2	0·60	265	2·35	41·94	35·24
18	,,	Tirto	86·3	85·36	80·92	27·0	32·29	31·51	38·94	29·41	6·32	2 29	13·65	— 17·0	0·70	190	4·65	54·79	37·36
19	,,	Tjomal	..	79·98	73·08	26·1	29·37	32·50	40·19	20·00	8·37	2·62	15·34	— 16·3	0·82	109	2·44	..	..
20	,,	Trangkil	85·65	90·60	85·10	29·3	36·3	32·34	42·65	22·8	8·75	2·13	17·25	— 30·7	0·63	244	2·61	53·31	43·00
21	,,	Winongan	83·2	87·38	83·61	26·0	32·31	29·75	38·64	27·03	7·61	1·72	15·66	— 34·5	0·50	197	3·55	53·54	44·56
22	,,	Wonosari	88·22	80·64	76·42	33·2	36·9	41·17	48·29	21·3	7·33	1·50	10·89	— 17·4	0·58	152	2·91	45·05	37·93

I.—MOLASSES CENTRIFUGALLED DIRECTLY FROM FIRST SUGAR MASSE-CUITES.—*(Continued.)*

Number.	Method of Clarification.	Name of the Factory.	Total Ash.	Ash insoluble in water.	Ash soluble in water.	Iron and Calcium Phosphate.	Lime.	Magnesia.	Potash.	Soda.	Silica.	Sulphuric Acid.	Carbonic Acid in the Ash.	Chlorine.	Lime in 100 parts of Ash.
1	Carb.	Djatiwangi	7·61	1·13	6·48	0·12	0·48	0·08	3·86	0 08	0·03	0·75	1·69	0·46	6·31
2	,,	Kadhipaten	7·26	2·13	5·13	0·12	1·16	0·02	3·38	0·13	0·62	0·23	2·19	0·16	16·01
3	,,	Kadhipaten	7·45	2·32	5·13	0·15	1·24	0·04	3 27	0·15	0·03	0·29	2·22	0·16	6·40
4	,,	Soerawinangon	9·47	1·39	8·08	0·15	0·68	0·02	5·11	0·00	0·15	0·74	2·56	0·37	7·19
5	Def.	Asembagoes	12·94	1·67	11·27	0·76	0·25	0·29	6·47	0·00	0·21	1·61	1·09	2 52	1·93
6	,,	Bogohkidoel..	8·88	2·04	6·84	0·62	0·52	0·17	3·96	0·00	0·27	1·18	1·39	0·52	5·85
7	,,	Kwarassan	8·02	1 88	6·14	0·49	0·67	0·20	3·61	0·02	0·18	1·26	1·33	0·42	8·35
8	,,	Kemantran, 1904	9·23	1·87	7·36	0·82	0·57	0·07	4·25	0·57	0·15	1·14	1·61	0·38	6·17
9	,,	Kentjong	8·21	1·66	6·55	0·42	0·96	0·16	3·93	0·20	0·13	0 82	1·69	0·34	11·69
10	,,	Maron	10·45	1·75	8·70	0·44	0·37	0·15	5·48	0·12	0·22	0·69	2·27	0·99	3·54
11	,,	Minggiran	9·23	2·18	7·05	0·41	0·85	0·17	4·01	0·04	0·15	1·41	1·60	0·64	9 21
12	,,	Pandaän	8·00	2·75	5·25	0·52	0 67	0·10	3·34	0·00	0·51	0·86	1·46	0·17	8·37
13	,,	Poerwoasri	8·39	2·10	6·29	0·76	0·47	0·49	3·76	0·13	0·34	1·21	1·15	0·68	5·61
14	,,	Sedati..	7·70	1·55	6·15	0·38	0·52	0·26	3·62	0 00	0·10	1·08	1·35	0·28	6·76
15	,,	Seloredjo	7·39	2·99	5·40	0·76	0·45	0·19	3·31	0·06	0·42	0·67	1·54	0·25	6·09
16	,,	Sragi	7·96	2·05	5·91	0 92	0·59	0·08	3·32	0 07	0·17	1·24	1·19	0·37	6·28
17	,,	Sroeni..	9·06	1·99	7·07	0·34	0·69	0·13	4·03	0·02	0·21	1·37	1·19	0·85	7·62
18	,,	Tirto	6·32	2·00	4·32	0 89	0·48	0·05	2·62	0·07	0·23	0·85	1·03	0·68	7·59
19	,,	Tjomal	8·37	1·88	6·54	1·13	0·29	0·05	3·89	0·11	0·11	0·91	1·67	0·54	3·47
20	,,	Trangkil	8·75	1·86	6·89	0·63	0·31	0·16	4·32	0·13	0·20	0·56	1·91	0·38	9·49
21	,,	Winongan	7·61	1·44	6·17	0·63	0·06	0·13	4·20	0·06	0·18	0 87	1·18	0·34	8·28
22	,,	Wonosari	7·33	2·39	4·94	0·61	0·49	0·14	2·98	0·06	0·35	0·85	1·19	0·35	6·68

II.—MOLASSES FROM AFTER-PRODUCT MASSE-CUITES DRAINED OFF AFTER COOLING IN TANKS.

Number.	Method of Clarification.	Name of the Factory.	Quotient Original Juice.	Degrees Brix.	Actual dry substance.	Direct Polarization.	Polarization after Clerget.	Apparent Quotient.	Real Quotient.	Glucose.	Ash.	Gummy matter.	Organic Non-sugar.	Rotatory power of the Glucose.	Factor for the Ash for the difference between Brix and dry substance.	Saccharose dissolved in 100 parts of water.	Ratio between Glucose and Ash.	Difference in quotient (apparent) between Juice and Molasses.	Difference in quotient (real) between Juice and Molasses.
23	Carb.	Boedoeran	85·00	82·98	77·80	30·3	29·9	36·63	38·43	25·3	8·49	0·83	13·11	+ 1·3	0·61	135	3·09	48·37	46·57
24	,,	Sewoe Galoor	81·5	83·38	78·49	31·6	32·13	37·90	49·94	19·61	9·21	0·85	17·54	— 2·6	0·52	150	2·13	43·6	40·56
25	,,	Tjebongan..	82·7	83·18	76·66	33·8	34·1	40·63	41·48	15·4	9·04	0·61	18·12	— 2·0	0·72	147	1·70	42·07	38·22
26	,,	Wonopringgo	..	84·82	77·64	30·8	30·9	36·31	39·94	21·7	8·03	0·70	17·10	— 0·5	0·89	134	2·70	..	..
27	Def.	Adiwerna	85·24	81·94	76·72	30·2	33·6	36·83	43·80	21·2	8·60	1·11	13·32	— 16·0	0·61	145	2·47	48·38	41·44
28	,,	Bagoe	86·3	84·66	77·36	27·6	33·78	32·60	43·67	24·39	9·24	2·47	9·95	— 27·8	0·79	149	2·64	53·7	42·63
29	,,	Balapoelang	83·44	80·92	77·52	23·8	27·7	29·41	35·86	27·8	7·14	1·69	14·88	— 14·0	0·48	123	3·89	54·03	47·58
30	,,	Bandjardawa	88·9	72·96	69·96	27·0	27·78	37·01	39·69	16·95	7·22	1·60	18·01	— 4·5	0·42	92	2·35	51·89	49·21
31	,,	Bodjong	89·94	87·00	82·76	29·8	32·1	34·25	38·79	26·3	8·09	1·91	16·27	— 8·7	0·52	186	3·25	55·69	51·15
32	,,	Braugkal	84·57	77·18	73·52	27·6	29·2	35·76	39·72	27·8	7·43	1·34	9·09	— 5·8	0·19	111	3·61	48·81	44·85
33	,,	Djati	89·27	89·18	84·50	35·3	40·9	39·58	48·02	22·8	8·35	1·44	12·45	— 24·5	0·56	264	2·73	49·69	41·25
34	,,	Djatibarang..	89·12	83·76	77·92	30·4	33·5	36·29	43·00	17·51	9·20	1·54	17·71	— 17·7	0·63	152	1·90	52·83	46·12
35	,,	Doekoewringin ..	..	85·04	78·40	24·9	27·9	29·29	35·59	27·8	8·32	1·89	14·38	— 10·8	0·80	130	3·34	..	..
36	,,	Gending	82·49	87·75	80·72	26·2	33·11	29·86	41·18	22·73	11·40	2·08	13·48	— 30·4	0·62	172	1·98	52·63	41·31
37	,,	Goedo..	83·77	87·12	81·53	26·8	30·76	33·85	36·17	29·94	9·31	1·66	12·79	— 9·0	0·60	161	3·22	53·01	47·60
38	,,	Kabat	..	85·65	78·86	26·2	33·42	30·59	42·38	24·39	9·20	1·64	11·15	— 29·6	0·76	158	2·65	..	..
39	,,	Kanigoro	86·3	82·98	79·32	28·6	31·99	34·47	40·33	27·03	7·04	1·50	13·26	— 12·5	0·52	155	3·98	51·8	45·97
40	,,	Karang Soewoeng ..	90·5	84·08	77·32	32·6	34·44	38·77	44·54	16·13	11·10	1·90	15·65	— 11·4	0·66	150	1·45	51·73	45·96
41	,,	Kemanglen	90·33	79·23	74·98	28·6	32·02	36·07	42·68	20·00	7·52	2·27	15·41	— 17·1	0·57	128	2·66	58·83	47·55
42	,,	Kemantran, 1903 ..	..	81·76	75·94	25·6	33·28	31·31	43·82	20·00	8·34	1·83	14·32	— 33·4	0·69	138	2·40	..	..
43	,,	Ketanggoenggan W.	86·62	84·58	78·50	27·4	34·00	32·39	43·31	20·00	9·58	2·02	14·92	— 33·0	0·63	158	2·09	54·23	43·31
44	,,	Ketegan	..	82·76	78·10	23·6	30·67	32·14	39·27	28·57	6·04	1·13	12·82	— 14·3	0·77	140	4·73	..	..
45	,,	Kremboong	86·82	84·44	80·44	21·8	26·1	25·82	32·45	32·3	7·97	1·22	14·07	— 13·3	0·50	122	4·05	61·00	54·37

II.—MOLASSES FROM AFTER-PRODUCT MASSE-CUITES DRAINED OFF AFTER COOLING IN TANKS.—(*Continued.*)

Number.	Method of Clarification.	Name of the Factory.	Total Ash.	Ash insoluble in water.	Ash soluble in water.	Iron and Calcium Phosphate.	Lime.	Magnesia.	Potash.	Soda.	Silica.	Sulphuric Acid.	Carbonic Acid in the Ash.	Chlorine.	Lime in 100 parts of Ash.
23	Carb.	Boedoeran	8·49	2·94	5·55	0·15	1·62	0·02	3·44	0·15	0·04	0·40	2·17	0·68	19·08
24	,,	Sewoe Galoor	9·21	3·89	5·32	0·19	2·08	0·05	2·48	0·10	0·03	0·40	3·83	0·61	21·49
25	,,	Tjebongan	9·04	3·04	6·00	0·09	1·62	0·00	3·99	0·17	0·00	0·16	2·70	0·37	17·92
26	,,	Wonopringgo	8·03	4·18	3·85	0·16	2·18	0·00	2·32	0·00	0·03	0·49	2·48	0·21	20·17
27	Def.	Adiwerna	8·60	2·40	6·20	0·37	0·77	0·14	3·76	0·44	0·10	1·01	1·32	0·45	8·95
28	,,	Bagoe..	9·24	1·53	7·71	0·91	0·20	0·07	4·68	0·15	0·18	0·85	1·49	0·72	2·16
29	,,	Balapoelang..	7·14	1·93	5·21	0·65	0·48	0·09	3·17	0·09	0·22	0·65	1·43	0·20	6·72
30	,,	Bandjardawa	7·22	1·84	5·38	0·55	0·54	0·15	3·24	0·06	0·16	0·74	1·50	0·24	7·48
31	,,	Bodjong	8·09	2·43	5·66	1·07	0·53	0·10	3·54	0·00	0·30	0·30	1·95	0·27	6·55
32	,,	Brangkal	7·43	1·85	5·58	0·60	0·46	0·09	3·31	0·14	0·30	0·86	1·17	0·58	6·19
33	,,	Djati	8·35	2·06	6·29	0·75	0·30	0·11	3 90	0·08	0·28	0·85	1·35	0·40	3·59
34	,,	Djatibarang	9·20	2·87	6·33	0·42	1·25	0·08	3·96	0·00	0·06	0·87	2·22	0·21	13·59
35	,,	Doekoewringin	8·32	2·51	5·81	0·66	0·65	0·26	3·44	0·25	0·36	1·19	1·54	0·23	7 93
36	,,	Gending	11·40	1·55	9·85	0·61	0·33	0·20	6·03	0·06	0·17	0·84	1·77	0 84	2·90
37	,,	Goedo	9·31	2·37	6·94	0·51	0·80	0·05	4·07	0·09	0·24	1·37	1·49	0·71	8·59
38	,,	Kabat..	9·20	1·17	8·03	0·52	0·24	0·10	5·04	0·10	0·11	0·48	2·05	0·51	2·61
39	,,	Kanigoro	7·04	1·74	5·30	0·54	0·60	0·08	3·08	0·10	0·06	0·82	1·44	0·20	8·52
40	,,	Karang Soewoeng.. ..	11 10	2·10	9·00	0·55	0·73	0·22	5·35	0·06	0·03	1·29	1·91	0·95	6·58
41	,,	Kemanglen	7·52	2·33	5·19	0·94	0·46	0·20	3·10	0·04	0·31	0·86	1·39	0·21	6·12
42	,,	Kemantran, 1903	8·34	1·37	6·97	0·73	0·19	0·21	4·17	0·08	0·14	0·92	1·32	0·61	2·04
43	,,	Ketanggoengan W.	9·58	2 02	7·56	1·07	0·47	0·08	4·51	0·10	0·11	1·13	1·72	0·71	4·91
44	,,	Ketegan..	6·04	1·73	4·31	0·39	0·59	0·18	2·36	0·00	0·09	0·95	1·02	0·34	9·77
45	,,	Kremboong	7·97	1·85	6·12	0·72	0·36	0·12	3·64	0·14	0·24	1·08	1·34	0·55	4·52

II.—MOLASSES FROM AFTER-PRODUCT MASSE-CUITES AFTER COOLING IN TANKS.—(*Continued.*)

Number.	Method of Clarification.	Name of the Factory.	Quotient Original Juice.	Degrees Brix.	Actual dry substance,	Direct Polarization.	Polarization after Clerget.	Apparent Quotient.	Real Quotient.	Glucose.	Ash.	Gummy matter.	Organic Non-sugar.	Rotatory power of the Glucose.	Factor for the Ash for the difference between Brix and dry substance.	Saccharose dissolved in 100 parts of water.	Ratio between Glucose and Ash.	Difference in quotient (apparent) between Juice and Molasses.	Difference in quotient (real) between Juice and Molasses.
46	Def.	Krian..	81·7	82·86	78·87	24·0	28·35	28·96	35·95	29·41	7·02	2·31	14·09	— 14·8	0·56	134	4·17	52·74	45·75
47	,,	Majong	89·5	79·18	74·06	31·8	34·75	40·02	46·92	16·13	8·40	3·97	14·78	— 18·3	0·61	134	1·92	49·48	42·58
48	,,	Modjoagoeng	88·3	74·20	67·56	23·0	25·7	31·0	38·04	20·8	7·68	1·55	13·38	— 13·0	0·86	80	2·71	57·3	50·26
49	,,	Modjopangoeng	84·90	68·65	66·30	..	..	..	..	..	6·24	1·22	..	..	..	..	..	..	..
50	,,	Nieuw Tersana ..	89·0	91·16	85·30	31·8	37·20	34·88	43·61	21·28	9·98	2·62	16·84	— 25·4	0·59	253	2·13	54·12	45·39
51	,,	Oemboel	84·82	81·38	75·14	26·8	30·8	32·93	40·09	24·4	9·14	1·61	8·67	— 16·4	0·68	124	2·67	51·35	44·73
52	,,	Olean	82·7	87·30	78·83	25·4	32·28	29·10	40·95	25·64	9·62	2·44	11·29	— 26·8	0·89	152	2·67	53·6	41·75
53	,,	Padjarakan	83·56	83·46	77·66	29·6	34·49	35·47	44·41	24·39	9·30	2·47	9·48	— 20·5	0·62	154	2·62	48·09	39·15
54	,,	Pagonan	..	86·14	80·32	25·8	31·39	29·95	39·08	27·03	8·31	1·61	13·59	— 20·4	0·70	160	3·25	..	..
55	,,	Pakies	84·9	83·50	78·40	24·9	27·9	29·29	35·59	29·4	7·04	1·50	12·52	— 17·4	0·77	133	4·17	56·16	49·31
56	,,	Pandji	..	83·12	77·42	27·4	32·91	32·93	42·52	27·03	7·92	1·39	9·56	— 20·4	0·72	141	3·41	..	..
57	,,	Perning..	82·50	81·76	77·62	26·2	31·78	32·04	39·66	28·57	6·79	1·31	11·48	— 16·0	0·61	138	4·21	50·46	42·84
58	,,	Petjangaän	..	81·80	74·46	27·4	32·72	33·49	43·94	20·41	9·00	4·41	12·33	— 26·0	0·82	128	2·27	..	..
59	,,	Phaëton..	..	85·70	78·72	27·0	31·78	31·50	40·48	22·73	9·91	1·53	14·21	— 21·4	0·70	150	2·40	..	..
60	,,	Poerwokerto	85·47	84·40	80·06	29·2	32·12	34·60	40·12	22·73	8·77	3·14	16·44	— 12·9	0·50	161	2·59	50·87	45·35
61	,,	Pradjekan	82·1	82·42	78·54	29·0	34·3	35·19	46·91	27·8	7·89	1·14	8·55	— 19·1	0·49	160	3·54	46·91	35·19
62	,,	Remboen	85·0	82·80	78·04	29·2	31·40	35·25	40·23	25·00	8·27	1·35	13·37	— 8·8	0·57	144	3·02	49·47	44·77
63	,,	Seboroh..	88·7	85·30	78·84	27·4	32·81	32·12	41·62	19·61	10·06	2·33	16·36	— 28·1	0·64	155	1·95	56·58	47·08
64	,,	Sindang laoet	90·5	80·98	76·26	33·8	37·20	41·74	48·78	14·93	8·93	2·58	15·20	— 22·9	0·53	159	1·66	48·76	41·72
65	,,	Soekodono	85·0	88·74	84·10	32·6	35·42	36·73	42·12	26·32	9·55	1·49	12·81	— 10·7	0·49	223	2·76	48·27	42·88
66	,,	Soemberkareng ..	..	75·24	71·07	25·8	27·9	34·29	39·26	27·0	8·20	1·42	7·97	— 7·8	0·51	96	3·29	..	..
67	,,	Tandjong Tirto	..	79·70	76·12	28·1	34·09	35·25	44·78	22·22	6·90	3·92	13·91	— 27·0	0·52	147	3·22	..	..

II.—MOLASSES FROM AFTER-PRODUCT MASSE-CUITES AFTER COOLING IN TANKS.—*(Continued.)*

Number.	Method of Clarification.	Name of the Factory.	Total Ash.	Ash insoluble in water.	Ash soluble in water.	Iron and Calcium Phosphate.	Lime.	Magnesia.	Potash.	Soda.	Silica.	Sulphuric Acid.	Carbonic Acid in the Ash.	Chlorine.	Lime in 100 parts of Ash.
46	Def.	Krian..	7·02	1·97	5·05	0·71	0·51	0·05	3·00	0·07	0·21	0·84	1·33	0·30	7·27
47	,,	Majong	8·40	2·44	5·96	1·00	0·66	0·05	3·73	0·14	0·20	0·23	2·06	0·30	7·86
48	,,	Modjogaoeng	7·68	1·51	6·17	0·66	0·28	0·14	3·40	0·17	0·11	0·46	1·72	0·41	3·65
49	,,	Modjopanoeng	6·24	1·18	5·06	0·27	0·45	0·10	3·13	0·06	0·13	0·29	1·38	0·28	7·21
50	,,	Nieuw Tersana	9·93	1·76	8·22	0·84	0·28	0·22	4·98	0·11	0·24	1·29	1·51	0·82	2·81
51	,,	Oemboel	9·14	1·70	7·44	0·45	0·54	0·23	4·56	0·00	0·13	0·66	2 09	0·58	5·90
52	,,	Olean	9·62	1·42	8·20	0·82	0·30	0·06	5·07	0·05	0·14	0·93	1·70	0·68	3·12
53	,,	Padjarakan	9·30	2·44	6·86	1·05	0·43	0·19	4·27	0·00	0·40	0·60	1·80	0·74	4·62
54	,,	Pagongan..	8·31	1·58	6·73	0·66	0·36	0·16	4·06	0·01	0·18	1·23	1·23	0·44	4·33
55	,,	Pakies	7·04	1·64	5·40	0·55	0·46	0·16	3·50	0·00	0·16	0·28	1·46	0·59	6·53
56	,,	Pandjii	7·92	1·93	5·99	0·49	0·15	0·12	4·34	0·00	0·18	0·57	1·36	0·64	1·89
57	,,	Perning..	6·79	1·25	5·54	0·29	0·42	0·14	3·30	0·08	0·07	0·61	1·32	0·44	6·18
58	,,	Petjangaän	9·00	2·86	6·14	0·89	0·99	0·04	3·76	0·10	0·10	0·21	2·27	0·65	11·00
59	,,	*Phaëton*..	9·91	1·95	7·93	0·36	0·78	0·13	4·88	0·00	0·04	0·94	2·07	0·94	7·86
60	,,	Poerwokerto	8·77	2·82	5·95	1·30	0·49	0·02	3·62	0·10	0·36	0·34	1·82	0·38	5·59
61	,,	Pradjekan	7·89	1·29	6·60	0·58	0·09	0·16	3·88	0·11	0·22	0·51	1·59	0·41	1·14
62	,,	Remboen	8·27	2·32	5·95	0·47	0·87	0·09	3·48	0·16	0·34	0·73	1·76	0·45	10·52
63	,,	Seboroh..	10·16	2·61	7·55	1·06	0·60	0·22	4·44	0·14	0·21	1·08	1·99	0·30	5·91
64	,,	Sindang laoet	8·93	2·22	6·71	1·23	0·45	0·09	4·07	0 06	0·20	0·74	1·60	0·59	5·04
65	,,	Soekodono	9·55	2·03	7·52	0·33	0·83	0·08	4·45	0·14	0·11	0·68	1·97	0·65	8·69
66	,,	Soemberkareng	8·20	1·93	6·27	0·37	0·62	0·13	3·87	0·00	0·29	0·55	1·83	0·51	7·56
67	,,	Tandjong Tirto	6·90	1·78	5·12	0·58	0·60	0·10	3·20	0·08	0·03	0·32	1·71	0·17	8·99

Number.	Method of Clarification.	Name of the Factory.	Quotient Original Juice.	Degrees Brix.	Actual dry substance.	Direct Polarization.	Polarization after Clerget.	Apparent Quotient.	Real Quotient.	Glucose.	Ash.	Gummy matter.	Organic Non-sugar.	Rotatory power of the Glucose.	Factor of the Ash for the difference between Brix and dry substance.	Saccharose dissolved in 100 parts of water.	Ratio between Glucose and Ash.	Difference in quotient (apparent) between Juice and Molasses.	Difference in quotient (real) between Juice and Molasses.
68	Def.	Tandjongsari	83·5	86·83	81·50	25·2	31·33	29·02	38·43	27·78	9·53	1·84	12·86	— 22·7	0·56	170	2·92	54·48	45·07
69	,,	Tangarang	84·0	83·10	77·44	28·8	35·79	34·66	46·22	22·22	8·41	1·72	11·02	— 29·6	0·67	160	2·88	49·34	37·78
70	,,	Tjepiring	87·99	84·92	79·96	26·0	34·0	30·62	42·52	21·3	9·28	1·49	15·38	— 37·5	0·53	170	2·30	57·37	45·47
71	,,	Tjiledoek	87·43	84·10	77·45	30·0	36·53	35·91	47·17	17·24	7·92	1·39	15·92	— 37·8	0·86	162	2·22	51·52	40·26
72	,,	Tjoekir	87·2	85·46	79·33	25·4	29·65	29 84	37·37	30·30	8·35	1·36	11·03	— 14·0	0·73	144	3·63	56·36	49·83
73	,,	Toelangan	86·9	82·98	78·38	29·2	32·43	35·19	41·38	25·00	7·96	1·51	12·99	— 12·9	0·58	150	3·14	51·71	45·52
74	,,	Waroe	86·5	84·42	78·74	26·6	33·0	31·51	37·28	24·4	8·56	1·53	12·78	— 26·2	0·67	155	2·85	54·99	48·22
75	,,	Watoetoelis	82·0	84·68	79·50	30·0	36·08	35·34	45·38	27·47	6·73	1·96	8·62	— 22·1	0·77	176	4·09	46·66	36·62
76	,,	Wonoredjo	87·71	83·47	77·72	28·4	32·46	34·02	41·77	18·52	9·88	2·05	16·06	— 21·4	0·58	145	1·87	53·69	45·94
77	,,	X.*	..	72·50	69·21	..	..	..	..	27·78	7·00	1·28	..	..	0·47	..	..	..	..

Number.	Method of Clarification.	Name of the Factory.	Total Ash.	Ash insoluble in water.	Ash soluble in water.	Iron and Calcium Phosphate.	Lime.	Magnesia.	Potash.	Soda.	Silica.	Sulphuric Acid.	Carbonic Acid in the Ash.	Chlorine.	Lime in 100 parts of Ash.
68	Def.	Tandjongsari	9·53	1·43	8·10	0·83	0·11	0 16	4·91	0·25	0·13	0·94	1·48	0·93	1·15
69	,,	Tangarang	8·41	0·91	7·50	0·33	0·06	0·09	3·93	0·23	0·19	1·95	1·12	0·31	0·71
70	,,	Tjepiring	9·28	1·71	7·57	0·40	0·54	0·17	4·67	0·51	0·08	0·76	1·85	0·89	5·82
71	,,	Tjiledoek	7·76	2·60	5·16	1·01	0·43	0·15	3·83	0·05	0·30	0·69	1·79	0 31	5·54
72	,,	Tjoekir	8·35	1·92	6·43	0·59	0·60	0 07	3·76	0·14	0·16	1·07	1·57	0·52	7·19
73	,,	Toelangan	7·96	2·02	5·94	0·45	0·63	0·12	3·36	0·14	0·14	1·05	1·51	0·45	5·65
74	,,	Waroe	8·56	1·83	6·73	0·55	0·48	0·22	4·02	0·38	0·25	0·90	1·23	1·25	5·61
75	,,	Watoetoelis	6·73	2·20	4·53	1·04	0·36	0·13	2·72	0·00	0·27	0·93	1·09	0·38	5·35
76	,,	Wonoredjo	9 88	1·99	7·89	0·96	0·48	0·00	4·88	0·06	0·16	0·70	2·27	0·37	4·86
77	,,	X.*	7·00	2 08	4·92	0·41	0·91	0·10	3·01	0·00	0·09	0·65	1·57	0·30	13·00

* This sample was sent without bearing the factory's name.

(To be continued.)

THE WORLD'S SUGAR CROP, 1905-06.

The *Glasgow Herald*, in its survey of the sugar trade for 1905, discusses the probable supplies for the coming campaign. It says:—

If all the high hopes for reaping a golden harvest were last season centred in scarcity, the idea now is that the current campaign will prove so abnormally abundant as to create a dead level of low values beneficial only to the actual consumers of the article. This has, for some time past at all events, been the leading opinion, and resulting as it does from figures supplied through expert reports and circulars, those most generally accepted are here given.

CANE SUGAR CROP.

	Estimate 1905-6. Tons.
Cuba	1,150,000
Porto Rico	175,000
Trinidad	40,000
Barbados	45,000
Martinique	30,000
Guadeloupe	35,000
Demerara	110,000
Brazil	210,000
Java	1,000,000
Philippine Islands	110,000
Mauritius	190,000
Réunion	30,000
Jamaica	20,000
Minor Antilles	85,000
United States (including beet)	585,000
Peru	100,000
Egypt	70,000
Hawaii	370,000
Total cane sugar	4,355,000

BEETROOT SUGAR CROP.

Germany	2,375,000
Austria-Hungary	1,420,000
France	1,075,000
Russia	1,060,000
Belgium	325,000
Holland	200,000
Other countries	420,000
Total beetroot	6,875,000
Grand total	11,230,000

To this total there has to be added the balance of stock left over from the last campaign—namely, about 1,400,000 tons—thus bringing the full supply available for the world's requirements from September 1st, 1905, to August 31st, 1906, to the very important quantity of 12,630,000 tons.

The question that arises from all this is—Is such a total justifiable? It is the largest which ever confronted the trade, and as it seems to come under the category of prophecies which promise too much, its full acceptance, as a basis for directing very important affairs, may prove a trifle hazardous. The tendency to colour what is admittedly probable has heretofore been a special weakness in crop estimates, and it is quite possible that the recent exaggerations which occurred in relation to scarcity are again being repeated with reference to a position which promises abundance.

Having regard then to this frailty, it may not be amiss to consider the present statement in relation to that which immediately preceded the disasters from which the trade is only now emerging.

The area of 1,600,000 hectares, reported to be placed under cultivation at the opening of the campaign 1904-5, was stated to be capable of producing, under all ordinary circumstances, a crop equal to 5,390,000 tons, or 1$\frac{7}{20}$ tons per English acre. The area of cultivation for the current campaign was originally given as 1,780,000 hectares, and the production from this has been estimated at 6,725,000 tons, which means 1½ tons per acre. In the former instance the final test for sugar was 19·68 per cent., while in the latter it is only 17·87 per cent. On these bases, and having strict regard to all the elements which enter into the calculation, the present crop ought not to exceed 6,400,000 tons, or fully 475,000 tons under the highest of the expert estimates.

The estimate of the cane crop at 4,355,000 tons seems equally doubtful, but in an opposite direction, and having in view the uncertainty of what Cuba may soon do, something between this figure and 4,800,000 tons may in all probability constitute the final supply from this source.

But putting aside any difference of opinion on this subject, and accepting of those estimates which have become popular, the next question comes to be—What are the prospects for the disposal of so great a quantity as 12,630,000 tons?

Throughout the whole of the present year the conditions affecting the trade have been precisely of a nature eminently calculated to create an environment which renders this question by no means difficult to answer. Long before the extreme price of 16s. 3d. had been reached in January last the general consumption of the article began to decline, while the new sources which the Convention had tapped quickly dried up. This state of things lasted for fully twelve months. In the campaign 1903-4, when the price of beetroot long remained in the neighbourhood of 8s., the outlet for the supply absorbed no less than 10,500,000 tons, whereas in that of 1904-5, when 16s. 3d. was reached, and 11s. 6½d. became the average of the year, the quantity needed fell to fully 1,000,000 tons short of that figure. Now as the year comes to a close the value again stands reduced to little over 8s. per cwt., and the old outlets for consumption and the drainage of supplies into invisible stocks have again resumed their former activity. Since the beginning of the current campaign, on 1st September last, and down to the end of last month, requirements have been increased to the extent of 174,000 tons over those of the corresponding three months of last year, and the remaining nine months, which will compare with the sadly emaciated demand during the corresponding period of 1904-5, are certain to show striking differences in the same direction.

It is thus already clear enough what environment of price can do towards answering the question. But the matter of value is not the only favourable point in the situation. The full estimate, even if substantially borne out, altogether fits in with the present state of affairs. The invisible supplies, as the result of discredited speculative events, extending over an entire year, have been reduced to a shadow, and must be replenished. The Eastern and other non-statistical outlets, which during that time became practically inert, are already proving their importance in the heavy engagements entered upon for their future supply. The diminished power of the ordinary and settled sources of consumption throughout the statistical area is, as has been already seen, rapidly reviving, while those new sources which the Convention created, and which the speculation temporarily closed, are again contributing to the general expansion. And, besides all these considerations bearing directly on the subject, the general improvement in trade and the increased and increasing spending power of the people ought to quicken the business entering these channels of consumption.

With a supply, therefore, estimated at a figure large enough to appear a somewhat hazardous guess, and a prospective demand which appears all but illimitable, it is difficult to conceive of a situation so encompassed proving other than attractive. It has always hitherto been found that nothing can equal progression, in the matter of consumption, for providing opportunities for profitable business. This apparently is what the new situation supplies. So conspicuous, indeed, are its merits in this respect that the end of it all may well enough be the discovery of yet another miscalculation.

It appears not improbable the balance on 31st August next will be quite 500,000 tons under the expert estimate of over 2,000,000 tons, and that something again in the region of 1,400,000 tons will be all that is left to pass on to the next account.

It is proposed to establish a sugar market at Havre, which would facilitate sugar exports to England.

SCALE IN EVAPORATORS.

By H. C. Prinsen Geerligs and H. Tervooren.

When analyzing the scum, which is removed from clarified and subsided cane juice by sand filters or by filtration over very fine metallic wire gauze, we were struck by its resemblance to the analysis of the scales from the first vessels of evaporators. This, in connection with the fact that in a factory, where the juice passes through a sand filter, the first vessel of the quadruple effet was only slightly incrusted, led us to the supposition that perhaps the scale of first vessels consists chiefly of constituents, that are not dissolved but only suspended in the juice. That from the other vessels contains matter, which is really dissolved but gradually deposits itself on the tubes because it becomes insoluble, either through the fall in temperature, or by the higher concentration of the sugar solution in which it was dissolved, or by the rise in its own concentration.

If this supposition was the right one, then a thorough filtration of the clarified juice would keep at least the first vessel of the evaporator clean. We thereupon collected the scale off the tubes in triple or quadruple effets of factories (1) working with the common defecation process; (2) liming the juice heavily in the cold, saturating with sulphurous acid and afterwards defecating as usual; (3) working with double carbonatation; (4) working with single carbonatation; (5) working with the combined defecation and carbonatation process.

We requested that the samples should be taken from the tubes before the vessels were boiled out with caustic soda, and, if this were not possible, to state how many hours that treatment had lasted. The majority of the scales were, it is true, treated with soda, but luckily we came into possession of at least one requisite sample from all the vessels of factories belonging to every one of the different classes.

The analyses follow here, all calculated on 100 parts of dry substance, after subtracting the weight of the particles of metal from the tubes, passed along in the samples by the scraping of the tubes.

The constitution of the scale from the first vessel is of great similarity to that of the scums, from, respectively, a defecation or a carbonatation factory filter-press, when calculated on 100 parts of dry substance, while the deposit in a syrup tank is similar to the scale from the latter vessels, as will be seen from Table II.

TABLE I.

Constituents.	Defecation with minimum Lime.				Defecation with much Lime and saturation with Sulphurous Acid.			Double carbonatation.			Single carbonatation.			Combined defecation, carbonatation and sulfitation.			
	I.	II.	III.	IV.	I.	II.	III.	I.	II.	III.	I.	II.	III.	I.	II.	III.	IV.
Loss on incineration	22·28	25·97	31·62	39·91	24·35	30·63	33·58	9·65	15·33	30·76	34·58	40·63	42·25	27·66	32·67	25·30	39·74
Silica	5·64	14·26	41·75	18·45	2·14	2·83	40·32	12·03	42·09	42·40	24·91	38·99	14·22	1·20	2·80	2·00	2·80
Phosphoric Acid	29·25	22·12	9·83	2·70	23·12	21·65	7·51	0·61	0·18	0·00	0·42	0·00	0·00	0·52	0·20	0·00	0·00
Sulphuric Acid.	1·90	2·31	0·45	0·26	7·92	5·48	2·36	1·13	0·81	0·27	0·38	0·00	0·00	0·61	0·32	0·10	0·00
Sulphurous Acid	0·00	0·00	0·00	0·00	0·50	0·36	0·00	0·00	0·00	0·00	0·00	0·00	0·00	32·05	23·73	28·00	2·19
Carbonic Acid..	0·57	0·55	0·38	11·50	0·25	0·47	0·00	27·19	10·03	5·56	8·04	0·52	0·44	1·10	1·00	2·20	2·10
Oxalic Acid .	0·00	0·00	1·37	5·00	0·00	0·00	2·77	0·00	0·87	6·94	0·00	4·65	30·01	0·00	9·80	11·45	41·90
Iron Oxide...	1·47	2·20	0·76	1·69	8·11	7·44	0·51	4·54	5·28	3·75	16·32	11·71	4·72	2·42	2·30	1·42	0·63
Alumina	0·30	0·39	0·13	0·81	0·00	0·00	0·00	6·50	10·09	1·32	0·86	0·44	0·00	0·00	0·00	0·00	0·00
Lime	39·13	31·96	13·97	23·42	31·90	29·35	13·09	38·54	16·27	12·30	12·81	4·31	21·47	30·91	29·06	34·60	30·91
Nitrogen.. ..	0·13	0·31	0·13	0·27	0·32	0·22	0·11	0·23	0·13	0·09	0·41	0·17	0·13	0·21	0·19	0·06	0·03
Wax and Fat..	0·71	0·84	0·19	0·47	1·45	0·46	0·53	0·66	0·59	0·52	0·93	0·40	0·16	1·02	0·62	0·12	0·18

TABLE II.

		Scums from		
Constituents.	Defecation.	Single Carbonation.	Double Carbonation.	Deposit from a Syrup tank.
Loss on incineration	58·2	12·5	15·7	36·33
Silica	1·9	11·4	6·4	26·95
Phosphoric Acid	7·0	0·7	1·0	12·25
Sulphuric Acid	absent	—	—	2·03
Carbonic Acid	absent	30·7	30·3	0·23
Iron Oxide and Alumina	7·2	2·4	5·2	3 58
Lime	8·1	39·6	38·5	19·45
Magnesia	1·1	—	—	—
Albuminoids	9·80	2·5	0·48	—
Fat and Wax	21·5	3·4	2·8	1·36
Sand	14·5	—	—	—

The figures indeed show that the incrustations in the first vessels contained the suspended particles, while the incrustations deposited in the vessels where the juice is already more concentrated, were dissolved in the clarified juice. In one instance, the scales from a last vessel almost entirely consisted of calcium oxalate, which became insoluble by the increased concentration of the sugar solution.

Oxalate and sulphite of calcium are insoluble in water, but distinctly soluble in sugar solution, and this more or the less according as the solutions have an alkaline reaction or contain potash salts, as is generally the case with cane juice.

Rümpler and Bresler's* experiments have shown that at the temperature of the juice during manufacture, the solubility of calcium oxalate in sugar solution decreases as the concentration of the sugar increases and the temperature sinks, causing three factors to combine their precipitating power when evaporating cane juice in the triple effet, namely, evaporation of the solvent, increase of concentration of the sugar, and fall in the temperature.

According to Geese's † researches, calcium sulphite is much less soluble at a high temperature than at a low one and, contrary to the oxalate, is also less soluble in an alkaline solution than in a neutral or acid one. This explains how an excessive treatment with sulphurous acid leads to a great deal of calcium sulphite becoming dissolved, especially when during subsiding the temperature sinks and thus the solubility increases. On evaporation, the calcium sulphite is therefore already insoluble at the highest temperature, or in the first vessels.

According to Pellet ‡ and other authors, the lime contained in calcium aluminate or silicate is gradually liberated during the heating of their solution in juice, leaving insoluble alumina and silica, which latter is to be found in well-nigh every incrustation.

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* Deutsche Zuckerindustrie, 1900, 439. † Vereinszeitschrift, 48, 103.

‡ Bulletin de l'Association des Chimistes, 18, 113.

We ascertained as a result of special investigations that calcium phosphate is very sparingly soluble in saccharine liquids, and no more soluble in an acid medium than in a neutral or alkaline one, so that only very little calcium phosphate can be deposited from a real solution. When, however, the scales in the first vessels contain much of that salt, it is a proof that the calcium phosphate has not been present in the juice in a dissolved state, but gelatinous and in suspension. This fact is further confirmed by the knowledge that the juice from carbonatation, which is filtered in presses and not merely clarified by subsiding, does not contain appreciable quantities of calcium phosphate.

Now we come to the question of how those incrustations may be prevented, or, if there exists no remedy against their formation, how they may be removed with the least trouble or expense. It is evident that a good filtration through sand or fine wire gauze will keep back much of the gelatinous bodies, and next that a neutral juice will dissolve, and therefore also deposit afterwards less lime salts than either an alkaline or an acid one. As, however, the juice is usually slightly alkaline, the formation of scale cannot be prevented and the question how to keep the tubes constantly clean must remain unanswered; so the only alternative is that of removing them. The scale is soluble in hydrochloric acid, but that also attacks the iron vessels, so is not advisable. Very diluted hydrochloric acid is not powerful enough to attack the scale of oxalates and the silica, so it is much better to boil the vessels with a solution of caustic soda under atmospheric pressure, or with open sight-glass. This treatment does not exactly *dissolve* the scale, but it loosens it and facilitates the scraping. The table underneath shows how little the boiling soda-lye affects the constitution of the incrustations. They represent the analyses of the scales of the different vessels of a defecation and a carbonatation factory after treatment with soda, and demonstrate how little they differ from those of the former-mentioned scales previous to the boiling.

	Defecation treated with soda-lye.				Carbonatation treated with soda-lye.		
	I.	II.	III.	IV.	I.	II.	III.
Loss on incineration	26·20	27·60	40·01	35·30	24·92	33·55	27·00
Silica	7·28	8·43	22·49	39·01	44·19	42·98	35·85
Phosphoric acid	20·91	19·85	1·61	0·37	0·45	0·26	—
Sulphuric acid.	4·87	3·38	0·43	—	0·60	0·31	—
Sulphurous acid	—	—	—	—	—	—	—
Carbonic acid	3·97	4·08	3·06	3·81	2·68	2·74	3·46
Oxalic acid	—	—	20·49	12·60	—	—	10·97
Iron oxide	2·24	3·47	0·69	0·55	20·11	12·14	14·54
Alumina	—	—	—	—	1·22	1·41	0·48
Lime	34·29	31·28	20·15	13·96	5·64	5·69	12·01
Nitrogen	0·09	0·13	0·25	0·14	0·22	0·24	0·15
Wax and fat	0·67	0·96	0·20	0·27	0·68	0·89	0·32

Besides the scale in the inside of the tubes, we sometimes found also incrustations on their outside in the steam chamber of the first vessels. The exhausted steam from the mills carries along from the cylinders part of the lubricating oil and deposits it together with iron oxide, aluminium, graphite and other matter on a spot where it gets condensed or on the outside of the brass tubes. A few analyses of such greasy, non-conductive teguments follow here, of which the first dates from 15 years back, and contains vegetable fat, while the other two are of a remote date after the introduction of mineral oil as a lubricator, and consist chiefly of that kind of oil, which could even be distilled off from the fatty mass by heating it in a test tube. The residuum of the distillation contained iron, copper, and lead oxide, and in two cases also graphite.

The figures in the tables are calculated on 100 parts of dry substance.

	I.	II.	III.
Mineral oil	—	28·50	13·90
Vegetable fat	28·40	—	—
Iron oxide	39·40	58·80	82·60
Copper oxide	30·00	2·50	—
Lead oxide	1·30	6·20	2·30
Graphite, &c.	0·90	4·00	1·20
	100·00	100·00	100·00

The fatty mass in the steam chamber is a non-conductor and decreases the capacity of the first vessel considerably. It is therefore necessary every season to inspect the steam chamber of the first vessel to see whether it is dirty or not. Chemical agents have no action on the stiff and greasy concoction of mineral oil and iron rust, so we need not try to boil it away with soda-lye or other solvents; the only remedy is to open the steam chamber, take out the brass tubes, and scrape them clean.

In the whole of Germany just 1% of the land is under beet cultivation, but in some of the provinces the proportion is 15 or 20 per cent.

The year 1904-05 has been a memorable one in the history of British Guiana in that its sugar crop was reaped and sold for the first time free from the unfair competition of bounty-fed beet sugar.

THE MANUFACTURE OF SUGAR FROM BRITISH GROWN BEET.

By Sigmund Stein
(Sugar Expert, Liverpool).

On December 6th, last Mr. Sigmund Stein read a paper under the above title at the Society of Arts, when the Right Hon. the Earl of Denbigh, C.V.O., was in the chair. There was a large and interested audience, and Mr. Stein's arguments were followed with close attention. We give below the principal parts of his paper, together with some particulars of the discussion which followed, for all which we are indebted to the *Journal of the Society of Arts.*

After some preliminary remarks, Mr. Stein said:—The question is settled, after many years of talk, that our climate and country are suitable for beetroot growing. I am very glad for this victory, for which I have worked for so many years, devoted so much of my time and a great deal of money, all of which have caused me very much trouble and anxiety, in persuading my fellow countrymen of the feasibility of growing beetroot.

We will now discuss the several aspects of the problem. There is first:—

The Labour Question.

Now that the most important question is settled, another has arisen, namely, can we find enough labour in this country, and if we can find it, how much would this labour cost us? Really it is a very reasonable question. I have written pamphlet after pamphlet regarding the matter, and I have inquired in all parts of the country about the quantity of labour to be got there and the prices paid to the labouring classes, and I have the entire satisfaction of knowing that sufficient agricultural labour could be obtained in this country, and that the wages would not be any higher than on the Continent of Europe. I had the utmost satisfaction in this respect when I took a party of gentlemen from England to the Continent, and enabled them to inquire for themselves into the cost of labour there, and they were perfectly satisfied that we here in England had the same advantages with regard to labour as the people on the Continent. The report they brought back with them lies before me now on the table, and they say that "the cost of labour on the Continent is not any lower than here in England." If any gentleman doubts me, I can prove to him on the best authority that my statements are correct.

I am not a professional political economist, but so far as my knowledge in political economy extends, I can see and realize that much shortsightedness exists in certain quarters. Yet we should bear in mind that charity begins at home: let us see that our fellow citizens have got bread, and if they have it we shall have satisfaction in everything, satisfaction with regard to the condition of health and mind, and knowing that we are bringing up a healthy future generation.

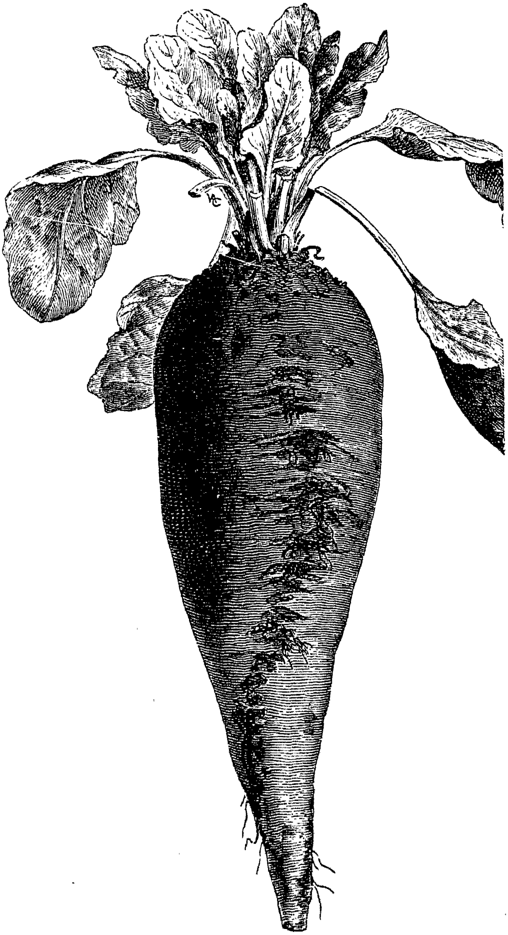

Fig. 1.—Sugar Beet, Vilmorin *(à collet rose)*.

I have experimented for many years in growing sugar beetroots practically in every county in England, Scotland, and Ireland. I have proved by nearly 2,500 experiments that we in this country can grow better beetroots than they can on the Continent, and more tons per acre than our Continental competitors.

Beetroots can be grown nearly everywhere, on almost any kind of soil. The beet is a plant which grows very patiently, and can endure great hardship. The cultivation is not difficult, as my experiments with many hundreds of farmer friends have proved. My instructions for growing beetroots have been sent broadcast into the remotest corners of our country. I have been able to record yields of 40 tons of roots per acre, but the general average for all these years amounts to about 17 tons per acre. Regarding the saccharine strength of the roots, I have found roots in England showing as much as 21 per cent. of sugar, but the average is about 17 per cent., which compares very favourably with the sugar content of the Continental grown roots.

I have been invited lately by different farmers' societies, various chambers of commerce, and county and town councils, to lecture on this subject and to express my views. I have always found the farmers very willing to take up the cultivation of sugar beetroots, if they could find a factory which would contract with them for a number of years. The farmers are very anxious to grow sugar beetroots, because they have found out after several years' experiments that after calculating the cost of cultivation and all other necessary expenses, the yield per acre of roots would give them a very handsome profit, if they could receive for their beets as much as 18s. per ton. I issued a few years back a balance-sheet for the beet-growing farmer, a document which was criticised on all sides. But, you will always find some people in this world who are very glad to be over-sceptical, and who have always ready a bucket of cold water to throw on any scheme of which they have no knowledge, and which is not in sympathy with their own ideas. They criticised my balance-sheet, saying that I had put the expenses of sugar beet-growing too low. I disputed the point with them and said that they were wrong and that I was right, but they still stuck to their views. But, after many years' struggle, I am now in the happy position (and I am supported by many great land-owners and agriculturists, and by many people who have grown sugar-beet experimentally for a considerable number of years) not only to be able to maintain the cost I gave for the cultivation of sugar-beet, but, what is more, I have now to reduce it, and I give you below a new and revised balance-sheet for the beet-growing farmer.

First, let us have the estimate of the expenses to be incurred:—

COST PER ACRE OF GROWING SUGAR BEETROOTS.

	£	s.	d.
Rent and taxes	1	0	0
Clearing and forking weed stubble	0	1	0
Ten loads farmyard manure	1	5	6
Carting 10 loads fresh manure	0	5	6
Spreading manure	0	1	0
Ploughing 8 to 10 inches deep	0	8	0
Cultivating, including harrowing and rolling	0	6	0
Artificial manure	1	10	0
Sowing	0	2	6
Seed (20 lbs. at 4d.)	0	6	8
Drilling	0	1	0
Hoeing and thinning	0	10	0
Harvesting crop	0	10	0
Carting to factory 15 tons 3 miles, at 6d. per mile and ton and 3d. per ton labour	1	6	3
Total	£7	15	5

I expect there will be some strong dissent offered when this new and revised estimate of the cost of beet cultivation is made public, but I am prepared to maintain its accuracy. Now we will turn to the balance-sheet:—

BALANCE-SHEET OF THE BEET-GROWING FARMER.

Dr.	£	s.	d.	*Cr.*	£	s.	d.
Cost per acre to plant, cultivate, harvest, and deliver roots	7	15	5	Receipt for roots, 15 tons at 18s. ton	13	10	0
Extra carting to the factory for 15 tons roots	1	10	0	Value of 5 tons leaves and heads from roots	1	5	0
Profit per acre	7	4	7	Three tons slices (20 per cent. of quantity delivered) at 10s.	1	10	0
				Value saturation lime (free from factory)	0	5	0
Total	£16	10	0	Total	£16	10	0

You see by this balance-sheet there remains a considerable profit, which in any case leaves a good margin for discrepancies. I took, as a minimum crop, 15 tons of roots per acre. I also credited the farmer with five tons of leaves and heads from the roots. The roots are headed on the top, and a considerable piece is cut off; this part is the poorest in sugar, but the richest in salts, and so is not practicable for manufacturing purposes, but it is a very good cattle food, the leaves being also very good for the same purposes, and they remain with the farmer.

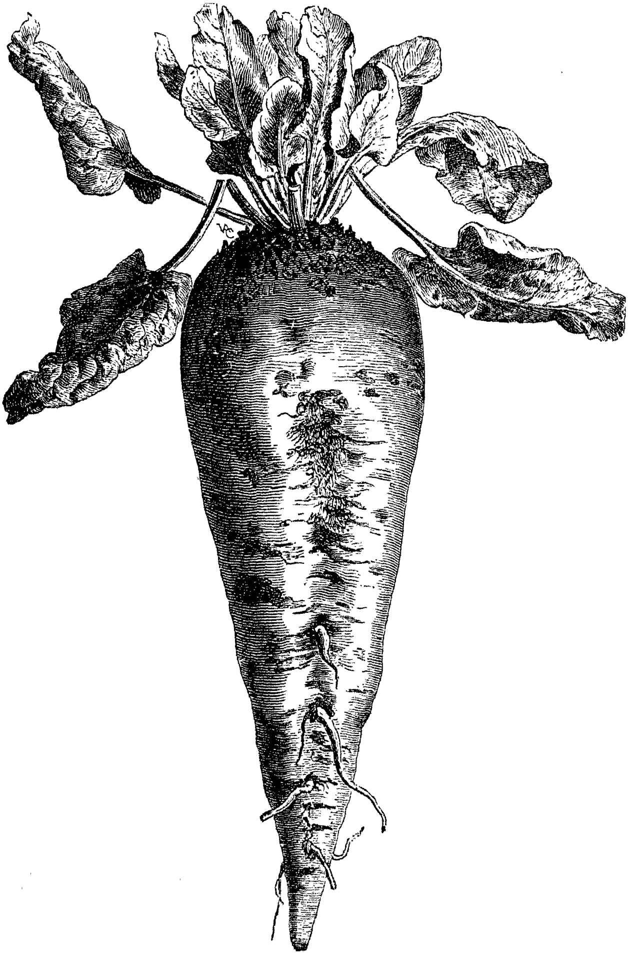

Fig. 2.—Sugar Beet, Vilmorin (Brabant).

When the roots are used for manufacturing purposes, they are cut into small slices, like vermicelli. These slices are diffused with hot water, and the sugar nearly all extracted. After the slices have been exhausted of their saccharine contents, they are removed from the factory, pressed out, and then sent back to the farmer, and he finds in them a very valuable cattle food. If you consider that the beetroot contains 80 per cent. of water, and the pressed slices about 30 per cent., you will see that the food value of these slices is very much superior to the beetroots, but, of course, you have abstracted from them the saccharine matter. These slices are given to the farmer partly free, and partly charged for. You see I credit the farmer with three tons of free slices. The farmer also receives a quantity of lime which is used in the manufacture of sugar, and is called "saturation lime"; it proves a splendid manure, because you find in it many ingredients of great manuring value.

THE EXTENT OF SUGAR-BEET GROWING.

Sugar-beet is grown in all countries of Europe; in Germany, Austria, Hungary, France, Holland, Belgium, Russia, Switzerland, and Denmark. Even countries as far north as Sweden, and South European countries, like Spain, cultivate beet. Italy, Servia, Roumania, Bulgaria, and Greece have well established beet factories. Eastward the beet cultivation exists as far as Persia and Siberia. It has also been tried in Manchuria, Australia (Victoria), and America (Canada and the United States).

The United States produced a few years ago only a few thousand tons of beet sugar: to-day their production amounts to about 265,000 tons per annum.

We also find sugar-beet culture carried on in Chili. I myself have tried successful experiments in Natal, and also in Barbados and the East Indies. I received a communication a few days ago from the Cape regarding the inauguration of the beet-sugar growing industry out there. You see, gentlemen, that the sugar-beet is a plant growing practically everywhere where civilisation exists.

PROCESS FOR MANUFACTURING SUGAR.

The factories I have in view to be erected in our country are to produce refined white sugar (granulated, crystals, and cubes) direct from the beetroot without the aid of animal charcoal, simply by my process, "The Stein process of refining without charcoal."

I submit to you in the following lines the way in which this refined sugar is manufactured direct from the beet:—

1. The beetroots are carted by the farmer to a shed in the factory.

2. The beets are next sent to the washing machine where they are freed from the adhering earth and dirt.

3. After washing, they are lifted by an elevator to the beetroot slicing machine. In this machine (which contains a special form of knife) the beetroots are cut into small slices.

4. These slices are put into large diffusers. Twelve to fifteen diffusers are placed in a circle or in two rows, and the sugar contents extracted from these slices with tepid water under pressure. The process is now so perfect that only about 0·2 per cent. of sugar will remain in the exhausted beetroot slices. These slices are placed in the press, where they are freed from the greater quantity of water they contain.

5. The raw juice is put into a vessel and treated with about 2 per cent. of lime. This lime process removes the organic impurities which the raw juice contains. After this, carbon dioxide is pumped into the limed juice. The lime is then precipitated, and forms carbonate of lime, whereupon the sugar liquor becomes bright, yellow and clear. This process is known as "Saturation."

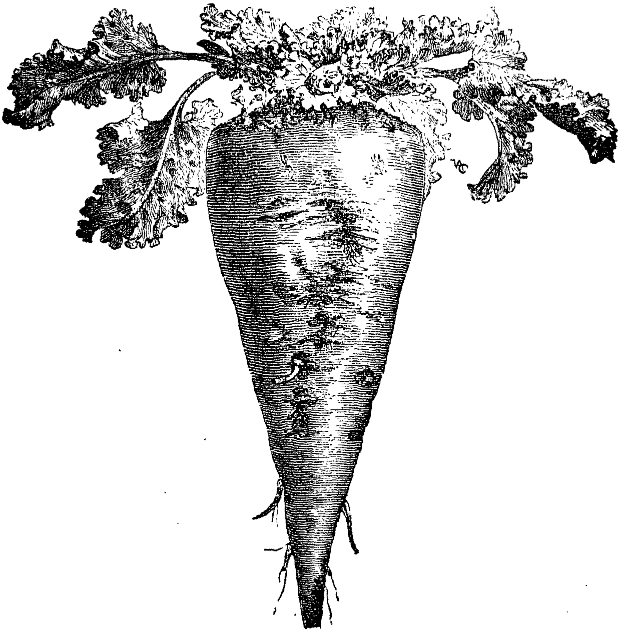

Fig. 3.—Sugar Beet (Klein-Wanzleiben).

6. The precipitate formed is separated from the liquor in a filter press, and the carbonate of lime remaining in a cake is used as manure, and is called "saturation lime."

7. The liquor is subsequently treated in a similar way with equal quantities of lime until all the organic impurities are removed.

8. After the last saturation, the liquor is again filtered and treated with sulphurous acid (SO_2). A further filtration removes the sulphide of lime which this treatment has produced.

9. The clear liquor which runs off from this last filtration is called "thin liquor," and gauges 5° to 8° Bé. It is then evaporated in a specially arranged series of vacuum pans to a concentration of 28° Bé.

10. The "thick liquor" is now submitted to the "Stein process of refining," which is a systematic treatment of the liquor to get rid of all impurities.

11. This thick liquor so prepared is boiled to crystals in the ordinary boiling vacuum pan, and the contents are called "masse-cuite." This masse-cuite contains the sugar crystals floating in a syrup or mother liquor.

12. The crystals are separated from the mother liquor in a centrifugal machine, and are treated there according to "Stein's method of manufacturing sugar" direct in the centrifugal machine, either for granulated crystals or cubes.

13. The final product (granulated, crystals, or cubes) is put into a drying stove, or Stein's drying apparatus, and after drying, is ready for packing and consumption.

You see the process is a simple and a systematic one, and involves very little expense indeed; and there you see lies the advantage of the British sugar maker, to refine sugar for consumption direct from the beetroots without passing it through a refinery. The British beet-sugar factory should be a refinery in itself, to work without charcoal and save thereby about 30 per cent. of the expenses.

PRICE OF SUGAR.

The present reduced price will surely increase consumption, and apart from that there will be an enormous increase in the distribution of sugar in all the trade channels of the world. The peculiar conditions prevailing in France have helped to bring about the panic in the market, the influence of which is felt now in a great degree. It is generally admitted that there has been a great exhaustion in the invisible supply of sugar throughout the world, because of the small crop in Europe last season, which is smaller than it has been for many years. As soon as the sugar prices become settled at any particular level there will unquestionably be a very material increase in the demand for sugar, and such an increase will lead to very much higher prices than are at present prevailing.

The estimate for the new beet crop has appeared, and is a very heavy forecast. There will be some difficulty in financing such a quantity of sugar this season, as the value of sugar, therefore, for forward delivery, say, for the summer months of 1906, shows a great premium. If the price of sugar only remains low for the next two or three months, there will certainly be a curtailment in the sowing next year, and this will result in advance of prices. Beet-sugar is at present at a price much below production, and the present cheapness must inevitably lead to a great increase in the consumption here and on the Continent. It is possible therefore that the fabricants on the Continent will prefer to store their sugar to provide for the growing wants of their customers. Should the financial support be sufficient to carry the immense supply of beet and cane sugars, there is no

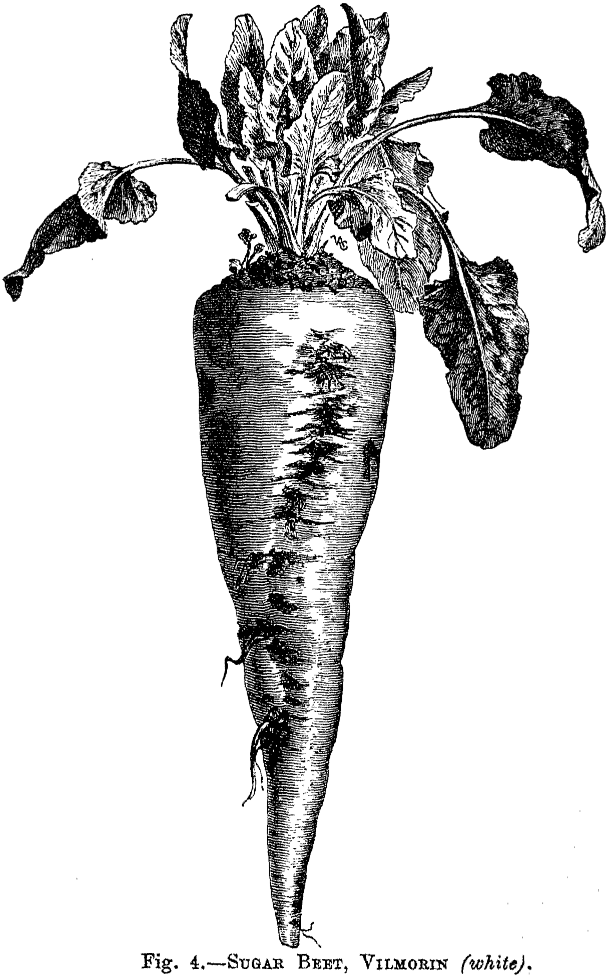

Fig. 4.—Sugar Beet, Vilmorin *(white)*.

reason why the prices should not improve considerably. There is no fear that the prices will remain for long as they are now, and I give you the following reasons why sugar must go up considerably:—

1. The large crop is not yet at hand. Not only will the regular transport be seriously affected by the continental rains, and thus considerably add to the risk of damage from frost, but also the analysis will suffer, and, as a consequence, considerable modification of the estimates may result.

2. The large crop is already discounted in the prices. It is a well-known fact that the present price is below the cost price, taking into consideration the prices paid for the roots. The consequence will be that the manufacturers after having delivered their sugar sold, will store the remainder, waiting for better prices.

3. It is striking that again no notice is taken of the replenishment of the consumed invisible stocks, whereas last year the existence of these invisible stocks was not taken into accouut. This year, the replenishment of the invisible stocks will absorb a considerable part of the surplus.

4. At these low prices, the sowing of beetroots must decrease very much. This will be especially the case in Germany, as in February, 1906, the corn import duties will be greatly increased, and the farmers consequently need not accept any price offered for the beetroots.

5. The high prices at the beginning of this year have caused sugar to be exported from countries which will not export at the present low prices.

THE FALL IN SUGAR PER CWT. SINCE JANUARY, 1905.

From the *Produce Markets' Review.*

1905.	1st Marks Granulated.			Foreign cubes.			Tate's cubes.		
	£	s.	d.	£	s.	d.	£	s.	d.
January 1st (highest point).	0	17	9¾	1	0	3	1	5	10½
February 1st	0	17	7½	1	0	3	1	5	10½
March 1st	0	16	9	0	18	9	1	5	1½
April 1st	0	16	3¾	0	18	7½	1	4	6
May 1st	0	14	10½	0	17	9	1	3	6
June 1st	0	13	10½	0	16	4½	1	2	4½
July 1st	0	13	1½	0	16	0	1	1	10½
August 1st	0	12	6	0	15	3	1	1	7½
September 1st	0	11	4½	0	14	0	0	19	10½
October 1st	0	10	8¼	0	13	3	0	19	10½
November 1st	0	9	10½	0	12	3	0	19	1½
Fall from highest point	0	7	11¼	0	8	0	0	6	9

In my previous publications I have mentioned the advantages which the introduction of sugar-beet growing, and the erection of sugar-beet factories, would bring to the English manufacturer, farmer, merchant, tradesman, and professional man, to the English railways, the English engineers, and to many other professions and trades. In short, I have pointed out how beet cultivation would increase the wealth of the country.

In spite of all these advantages for sugar-beet growing and for the erection of beet sugar factories, a start has not yet been made in this country to grow sugar-beet on a large scale and to manufacture the beet into sugar. Nobody, whether a capitalist, financier, sugar merchant, confectioner, jam maker, or anybody else interested in the erection of beet sugar factories, would put a penny down for the prospective sugar factory if they did not see beforehand that the invested capital would be a sure and safe investment for their money. Everybody is his own finance minister. Everybody first for himself, then for his fellowmen, and finally for the community in general.

I give you below the cost of producing refined sugar direct from the beetroots, and I also give you a balance-sheet of a prospective beet sugar factory to convince you decisively that it would pay to manufacture beet-sugar. I give you the following advantages which we have over our continental competitors:—

1. We can grow more roots per acre.

2. We can grow richer roots than on the Continent.

3. We have the consumption at hand, being the greatest sugar consumers in the world.

4. We save freight.

5. We save commission, as the factory sells direct to the consumer.

6. We can make use in the new installation of the latest improvements in cultivation and manufacture by having at our disposal the best implements and machinery.

7. We can manufacture in the prospective works refined sugar direct at a very low price.

8. We can employ the plant of our works in the summer months, after the campaign is over, much better than the factories can do on the Continent, as we have many other industries in this country which could be well carried out in this factory.

Cost of Producing Refined Sugar from Beetroots.

		£	s.	d.
Fuel: 12 per cent.; coal at 10s. 6d. per ton		0	1	3
Wages:—				
First process (preparative)		0	0	8
Second ,, (complete)		0	0	10
Third ,, (refining)		0	0	7
Limestone 4 per cent., at 6s. per ton—delivered		0	0	3
Coke	2·30d.	0	0	9
Leather and filtercloth	·60d.			
Bags	1·92d.			
Oil and grease	·55d.			
Light	·45d.			
Various materials	·62d.			
Laboratory	·56d.			
Selling commission	2·0d.			
Price of beetroots per ton		0	18	0
Sundry expenses		0	0	3
Expense of offices, management, &c.		0	2	5
		£1	5	0

So you see, calculating the beetroots at 18s. per ton, the whole cost of manufacture, including all expenses of office and management, would be 7s. per ton of beetroots.

(To be continued.)

EXTENT OF SUGAR BEET SOWING FOR 1906.

By Sigmund Stein

(Sugar Expert, Liverpool).

The question of the extent of beet sowing in the coming season occupies the minds of all the sugar merchants, brokers, and sugar consumers in general.

After the year of drought in 1904, one of the leanest years ever known in the production of beet sugar, came a year of superabundance, the season of 1905. The acreage of sugar beet sown in 1904 was 3,980,358 acres, and in 1905 4,643,037 acres. The production of beet sugar in 1904-05 was 4,706,900 tons, and the quantity to be produced during the present campaign (1905-06) is estimated at 6,875,000 tons. There will certainly be a surplus of sugar on the 1st of September, 1906, to be carried over to the campaign 1906-07, which will amount to 2,200,000 tons.

We must not forget that the over-production of cane sugar keeps pace with this over-production of beet sugar. In the same degree that the beet sugar manufacturers try to extend the capacity of their works, in the same measure does the cane sugar manufacturer extend his capacity for working from season to season, so as not to be left behind. The consumption, however, cannot increase in the same proportion.

Since the abolition of sugar bounties and the coming into force of the Brussels Convention (1st September, 1903), the consumption of sugar in Continental countries has increased greatly. This increase, however, will shortly cease, as people on the Continent are not accustomed to consume such a quantity of sugar as we do here in England, or as is done in the United States of America.

How will the matter end? What is to be the outcome of the sugar produced? Sugar is not an article that can be stored for years, on account of its bulky character; and another thing not to be lost sight of is the interest on the capital. We face to-day the same conditions as we did a few years ago, and I raised my voice then and wrote frequent articles warning beet growers and cane planters and sugar manufacturers to be very careful in the extent of their operations. The outcry raised at the time by shrewd persons, and the warnings given by experienced men, were taken into account and had their effect. The acreage of beet sowing and cane planting was reduced after a season of over-production. Yet how long is sugar to be sold under the cost of production? How long will manufacturers and growers throw their ready money through their factory windows? Is not the policy of not producing at all, and shutting the factory doors, better, than keeping the works going day and night, suffering any amount of trouble and in the end showing at the close of the season a large deficit, a crowd of disappointed shareholders, and a very unsettled state in the markets?

After the over-production of 1905 it was the belief amongst all classes that the next year (1906) would bring us a great reduction of beet sowing and cane cultivation. Yet, when I was on the Continent a few days ago, I noticed to my great surprise the contracting of beetroots at a price which shows at only a superficial calculation a great loss to the manufacturers. I saw prices of 95 pfennigs to one mark per cwt. were being offered to and accepted by the farmers. Everybody who has acquired only a rudimentary knowledge of this industry ought to see that there was a loss when this contract was made. I have heard that some contracts have been made at 75 to 80 pfennigs, but I have been assured that the level of 90 pfennigs to 95 pfennigs was offered on the average.

It is true that the manufacturers have works to keep up, and they wish to keep their concerns going, but they can do so even if they do not work up to the full capacity of their factories. If they curtail their working capacity by 25 to 30% they will still work at a profit if they can force the sugar beet-grower to reduce his sowings to a similar extent. The price of sugar is regulated by the supply and demand. If again there be too much sugar produced next year, prices must remain as they are or fall still lower. In that case, there is only one remedy for bringing people to their senses, and that is bankruptcy.

Continental manufacturers had on an average a good year in 1905, and the prices in January of that year reached a level not attained for 17 years, and they naturally made proper use of the high prices and sold at a handsome profit. They did not consider that this profit is only the natural consequence of the drought of 1904 and the subsequent nonsensical rise in price. They did not consider that this *coup* will not be repeated again, that the "corners" in France will never be re-established, and that the world in general has taken a good lesson from the smashes of last August and September.

The thundercloud I prophesied in this paper just a year ago came as I said, and many people have been buried under it, who, in their foolish and selfish policy, thought that they were wise and that their calculations would be adopted by the rest of the world. I give now a few words of warning, the same as I did twelve months ago. If only the large sugar societies on the Continent would take the matter in hand and organize amongst their members a plan for reducing the quantity of sugar beet to be sown and contracted for next season, and if cane planters would follow suit and only produce the quantity which will correspond with the consumption, we should soon see prices profitable to the grower and the manufacturer, and acceptable to the consumer.

SUGAR BEET GROWING IN EAST ANGLIA.

The following letter, which appeared in the *East Anglian Times*, is an interesting and valuable contribution to the discussion going on in our provincial press as to whether the time is now ripe for starting a beet sugar industry in the United Kingdom.

Sir,—I have read with a good deal of interest your article on the question of the manufacture of beet sugar, as for many years past I have considered the possibility of establishing the same in this country. So long as bounties are given to manufacturers on the Continent, I recognised the impossibility of any chance of the trade succeeding in England. But with their abolition the conditions were entirely altered, and I have therefore given a good deal of attention to the matter, and have visited several factories and interviewed growers in Germany, who were all most ready and willing to give me every information in their power.

From the figures which I was able to obtain, and which I have checked in a variety of ways, I consider after most careful investigation into every detail that I thought was necessary for the inquiry, that it is possible to establish a sugar factory with success in England, providing certain conditions, which I presently specify, are carried out.

The importations of beet sugar to this country are enormous, amounting to $1\frac{1}{4}$ million tons per annum, so that if one factory can be established with success it opens cut an immense field for enterprise for both growers and manufacturers in this country.

I do not attempt to enter into figures of the benefits in the way of employment of labour and capital, but I think it would be clear to everybody that the same would be prodigious.

Some 34 years ago an experiment was tried at Lavenham, in this county, with no successful results. I have made a few inquiries about this, and I find there were several reasons for failure.

The situation of the works was not a suitable one, as I shall later on be able to show; the complete manufacture was not carried out on the spot; about this period came the improved method of manufacture, and, finally, bounties were put on which effectually killed the industry as a profitable one. I hear from the manager of those works, who is still in active work in the sugar trade, that until the bounties were put on it was a financial success, but great difficulties were encountered with the local growers, and the proprietor, the late Mr. Duncan, who was a wealthy sugar refiner, gave it up—not being inclined to persevere with the difficulties of dealing with the farmers of that generation.

The conditions now in this year, 1905, are all altered.

1st. Bounties are all abolished.

2nd. A complete revolution in the mode of sugar manufacture.

3rd. Land is cheaper and rents are lower than in 1870-1873.

4th. Agricultural crops of all sorts are not of so much value.

5th. Terms of the Sugar Convention (about which I shall have something to say later on).

On September 19th, I visited the engineering works of the Brunswick Machine Building Company at Brunswick, where about 1,500 hands are employed; the staple manufacture of this works was the making of sugar machinery. I saw a number of machines in process of manufacture, and spent several hours in the drawing office, where the whole process was most carefully explained to me, with plans and verbal descriptions. I obtained some idea of the cost, and found myself at the end of the day sufficiently educated to visit a sugar factory with intelligence.

I think without this visit I should not have properly understood what I afterwards saw.

On the following day I visited Mr. Otto Licht, of Madgeburg, the official statistician of Germany for the sugar trade. He was kind enough to give me every detail I asked for as to figures of consumption of sugar, beet grown per acre, prices paid for roots, percentages of sugar in beet, amount of sugar per acre, and some other figures.

Returns of all the above have to be made by German law to the Government, and the figures I obtained I was assured may be taken as absolutely correct.

The next day I proceeded to Aderstedt, where I was met by Mr. Gotte, a large landed proprietor, owning and cultivating several thousand acres, of which about 2,500 acres were under cultivation of beet. Mr. Gotte was also principal proprietor of a very large factory, with a capital of something like £100,000.

I was entertained to lunch in a very fine old German castle, many centuries old, and was afterwards taken over the estate, and allowed to inspect the factory.

This factory dealt with 800 tons of beet roots per day of 24 hours; it was just getting ready to work, and the beets were being pulled on the day of my visit.

The next day I went to Waren, in Mecklenburg, about 100 miles west of Stettin, where I saw what I was told was the most up-to-date factory in Germany. The factory did not commence to work for a few days, so I had every opportunity of seeing all the machinery, and having everything explained to me.

I then returned to Brunswick, where I had an opportunity of visiting a factory at Peine, about 20 miles from that place, which was actually at work, and I saw the whole process, from unloading the beets from the carts to the sugar being bagged up for delivery to the trucks.

The information I obtained from these visits I give in as condensed a form as possible. I have converted all German weights and measures to English. It is possible that some small error may have crept in, but I do not think anything material.

I do not propose to give particulars of cultivation or process of manufacture, but only results.

I hope from the figures I give, the English farmers will be able to judge whether sugar beet would be profitable to grow.

Land in the beet-growing districts of Germany sells for £30 to £40 per acre, and is let at from 30s. to 40s. per acre.

The cost of cultivation of the crop, I was informed by Mr. Gotte, was £9 10s. per acre, including rent, rates, and taxes.

Under favourable circumstances, the average crop is 12 tons per acre, and 18s. 6d. is the average price paid for beet per ton, delivered at the factory. The weight in the above estimate is net weight, *i.e.*, after topping before removal from the farm, and washing at factory. A sample of every few loads is put into a test washing machine, and the quantity of earth estimated and deducted.

Nearly the whole of the circular top of the root is chopped off in the field and used for feeding purposes, and estimated to be worth 5s. per ton (I have only estimated it to be worth 3s. per ton).

The price of labour is about the same as in Suffolk, but I think more women and boys are employed than is general in England. The ploughing and carting to factory is almost altogether done by oxen. The following is what I estimate might be paid to the English grower :—

	£	s.	d.
Cultivation per acre and delivery to factory	9	18	0
Profit	1	16	0
	£11	14	0

	£	s.	d.
Beet sold to factory, 12 tons at 18s. 6d.	11	2	0
Tops, 4 tons at 3s.	0	12	0
	£11	14	0

The English farmer must judge for himself if the above figures apply in his case. They are arrived at after some conversations with leading local agricultural authorities.

The beet being delivered to factory in Germany (in most cases from two to three miles, though in some cases I heard of its being brought 20 or 30 by rail, but I fancy this is quite exceptional, and 1s. 6d. is put down as the average cost of carting), it passes through different processes until the sugar is obtained, which is bagged up and, if intended for England, is loaded on to trucks for Hamburg, where it is shipped either to London, Liverpool, or Glasgow.

The coal used in factories is usually half English and half Westphalian (a very inferior coal). Limestone, which is an important item in the manufacture, costs about the same as in England, varying of course by the distance of the quarry from the factory.

The price of skilled labour is lower than in England, but I think the ordinary labourer gets about the same money as in England.

The factory works from 60 to 80 days in the year, the campaign (which is the term used in the sugar trade) beginning about September 26th, and lasting till the end of the year; the remaining nine months the factory is idle, and the permanent staff of about 25 men is employed in cleaning and repairing ready for the next season.

At some factories which are not situated near the railway, a heavy cost for carting is incurred for coals and lime stone to the factory and carting away the sugar. At the Aderstedt factory which is about 1½ miles from the railway, I was informed their bill for the season amounted to £4000.

The freight from Brunswick to Hamburg is 5s. 6d. per ton for sugar.

Now, taking a factory which consumes 350 tons of roots per day of 24 hours, which is about the smallest size which could be profitably worked, I estimate we should get the following results on a proper site in England:—

Factory consuming 350 tons of roots per 24 hours.

Acreage employed, 1,800 acres.

Producing at 12 tons per acre—21,600 tons of beetroots.

Working 62 days.

Making 3,024 tons of sugar at 14 per cent. sugar in beet.

	£	s.	d.
21,600 tons roots at 18s. 6d.	19,980	0	0
1,728 tons coal at 14s.	1,209	12	0
648 tons lime at 13s.	421	4	0
30,240 bags at 3d.	378	0	0
Manager	600	0	0
Engineer, 52 weeks, at 40s.	104	0	0
24 men, 52 weeks, at 24s.	1,497	12	0
75 casual men, 9 weeks, at 21s.	708	15	0
Oil and light, say	200	0	0
Beet tester	52	0	0
Sundries, say	250	0	0
Depreciation on £30,000 at 5 per cent.	1,500	0	0
Rates—taxes	200	0	0
Profit (3¼ per cent. on £60,000)	1,950	17	0
	£29,052	0	0
3,024 tons sugar, £9, f.o.b. factory	27,216	0	0
4,320 tons slices at 5s.	1,080	0	0
324 tons molasses, at £2 6s. 8d.	756	0	0
	£29,052	0	0

If the price of sugar was £9 10s. per ton, the profit would be £3,462 17s., or 5·77 per cent. on capital.

The beet slices (*i.e.* the pressed beet) is returned to the grower, and is looked upon by him as a valuable feeding stuff. In Germany the farmer is anxious to contract to take it away, and it is not the case that the manufacturer has to force it upon him. In nearly all cases the German factories are carried on on the co-operative principle. The Peine Mill is owned by 425 shareholders, nearly all beet farmers, so that the profit on the working of a factory may be taken as a bonus on the price obtained for the beet.

Mr. Stein, of Liverpool, an expert in sugar manufacture, who has devoted his life to the question, has assisted me in my inquiries. Mr. Stein shows in his pamphlets a much more favourable result than I do. He may be right, I hope he is, but I can only speak on my own judgment.

Now, I think, comes the crucial question affecting the possibility of getting a profit in an English factory.

All sugar imported into this country pays a tax of £4 per ton, but by the Brussels Convention every country joining reserved themselves the right to remit to the manufacturer of sugar consumed in their own country the sum of £2 10s. per ton, so that it follows all sugar coming into this country pays £4 per ton, and would have to compete with sugar bearing a tax of only £1 10s. per ton.

To satisfy inquiries on this subject questions have been put to members of the Government, but they are met with the reply that no sugar is manufactured in this country, and therefore the question does not arise.

This would then put the English manufacturer in this position. The profit I have shown to be £1,950 17s. would then be £9,510 17s., and a percentage of 15·8 would be earned on a capital of, say, £60,000, which I estimate would be necessary for the mill of the above size and capacity.

But supposing £1 only was allowed as a drawback by the Excise, this would give a profit of £4,974 17s., or a percentage of 8·29 on the capital as below:—

Profit without drawback	£1,950 17s.	=	3·25 per cent.
Profit with drawback, £2 10s.. ..	£9,510 17s.	=	15·8 per cent.
Profit with drawback, £1	£4,974 17s.	=	8·29 per cent.

The capital required, £60,000, would be apportioned something like this:—

	£
Machinery	30,000
Site, water, wharf, and sundries	5,000
Buildings	5,000
Working capital	20,000
	£60,000

Now, supposing it could be shown, after further inquiry and full discussion, that it is possible to make sugar at a profit, the first consideration would be the choice of a site.

I consider that one could be found on the banks of the Orwell, Stour, or Deben, which would be an ideal one. These three rivers would give a coast-line of 70 or 80 miles of river bank, with a back land of two miles of good agricultural land, where beet could be shipped to a factory at a cost of not more than 1s. 3d. or 1s. 6d. per ton. Coals and limestone would have cheap water carriage to factory, and there would be a cheap water carriage to London for the sugar.

For this market the factory would have an advantage over the German one, inasmuch as the freight to Hamburg would be saved, and a lower freight to London of not more than 2s. 3d. or 2s. 6d., against 5s. from Hamburg to London.

Coals would be cheaper, as a set-off against somewhat lower-priced labour in Germany. I believe English brains are as good as German, and the intricacies and difficulties of the trade would soon be overcome by Englishmen.

To make the scheme a success, I think it would be necessary for landlords and tenant-farmers to co-operate by taking a share, large or small, in the factory, as is done in other countries. English farming methods are, I believe, superior to the Continent, and I think there would be a reasonable chance of benefit to landlord, grower, and factory shareholder.

It has been proved over and over again that beet can be grown in this country with as large a percentage of sugar as in other countries. A large grower at Lavenham, who grew beet there for the factory 33 years ago, tells me their results were sometimes as high as 17 per cent., whereas the average percentage in Germany is now 14·1 per cent.

No money could be promised for factory without first being able to ensure a supply of beet for, say, at least eight years, and it would therefore be necessary to secure an acreage of at least 1,800 acres guaranteed before anything could be done.

An agreement would have to be made binding on the grower in conjunction with the landlord to supply a fixed quantity at a certain price, taking the beet slices in return.

Such an agreement must necessarily be one-sided, as in case of fire or for any other reason a discontinuance of the working of the factory, the beet would have to remain on the farm, and a valuation of the roots as a feeding stuff would have to be made, but this is a detail which at this stage may well be left for after-consideration.

Without entering into the merits of Free Trade or Protection, I would like to point out that here is a trade which might be established in this country with a certainty of success, which would more than anything else help to settle the "Back to the Land" question. Six millions or more of money would be paid in wages, which is now sent over to Germany, provided the country would consent to a rebate on the tax of £4 per ton.

I have received offers to cultivate a very large quantity of land, some 600 or 700 acres. I believe I should not have much difficulty in getting the requisite quantity, provided a factory were established. But under the present conditions, *i.e.*, without the rebate I have referred to above, the inducement is not sufficient to invest my own capital, and I could not ask the public to invest theirs for a possible dividend of 3 per cent.

One gentleman has already told me he would invest £20,000 in a factory if I could get the same rebate—£2 10s.—which Germany, France, and Belgium obtain as per terms of the Convention.

I am, &c.,

FRANK W. MASON.

Northcliffe, Felixstowe.

CHEMICAL CONTROL OF CANE SUGAR FACTORIES.

WILLIAM D. HORNE, Ph.D.

The following notes are intended to afford a uniform method of chemical control of Cuban cane sugar factories working under diverse conditions.

The methods described have been compiled from the official methods employed in Java and in the Hawaiian Islands as well as from the experience of the writer and his collaborators in this field.

Some of the methods in use still require elaboration and perfecting.

For convenience in work the following notes have been grouped under the five general heads of Standardizing Apparatus, &c., Measurements, Sampling, Analyses and Calculations.

STANDARDIZING APPARATUS.

Balances and Weights.—See that the balance arms are of equal length by balancing weights against each other and then changing them to the opposite pans, where they should again balance each other. An analytical balance should be sensitive to 1-10 of a millegram. A sugar balance should be sensitive to 5 millegrams.

The weights must be standardized against properly certified standard weights and must be in correct relation to each other.

Brix Spindles are to be checked by means of the pycnometer, getting the specific gravity of sugar or molasses solutions at different densities.

$$\text{Sp. Gr. at } t^\circ\text{c} = \frac{\text{wt. of sugar sol. at } t^\circ \text{ C.}}{\text{wt. of water at } 17\cdot5^\circ \text{ C.} \times \frac{\text{wt. 1cc } H_2O \text{ at } t^\circ \text{ C.}}{\text{wt. 1cc } H_2O \text{ at } 17\cdot5^\circ \text{ C.}}}$$

Sugar flasks must all be standardized to be in accord with the polariscope used. This generally requires flasks holding 100 gms. of water at 17·5° C. Standardize a 100 cc. pipette to deliver this amount, and standardize all flasks by this.

To find the weight of water at t° C. which shall have the same volume (100 cc.) as 100 grams at 17·5° C. multiply 100 gms. by

$$\frac{\text{density of water at } t^\circ \text{ C.}}{\text{density of water at } 17\cdot5^\circ \text{ C.}}$$

Polariscopes must be set to be correct at zero and the deviations from the correct readings at several points on the scale between zero and 100 noted and allowance made for any such error in each reading made. The scale is to be checked by standard quartz plates and by solutions of sugar of known purity.

Polarization tubes should be tested as to length by means of standard metal tubes of 100 and 200 mm. length, respectively. Cover glasses should be tested to see that they are not optically active.

Quartz plates for standardizing the polariscopes should be compared annually with standard plates.

Thermometers should be compared with a standard thermometer which has been officially corrected.

Water meters should be standardized by weighing a quantity of water passed through.

Tank contents can be most accurately determined by filling from a barrel placed on a platform scale, weighing all water admitted and making a correction for temperature.

MEASUREMENTS.

Cane.—Weigh in cars or carts before bringing to the crusher. At the end of the day's run subtract cane weighed but not crushed from total cane weighed plus whatever was carried forward from preceding day. At the end of the week's run grind everything that has been weighed. Weigh the trash in one carload of cane once a week to determine the per cent. of trash in cane. Or, if practicable, collect all of the trash from cars and weigh daily.

Juice.—Weigh, if possible, the mixed juice. Otherwise measure in tanks of known capacity. This capacity is to be proved by filling with barrels of water weighed at a known and constant temperature up to an overflow pipe two inches in diameter or until a float with index above points to a certain height. The overflow is better. Take the temperature and a sample of each tankful. Make allowance for air volume in juice and for any precipitate of lime or other solids.

Bagasse.—Once a week or once a month weigh all the bagasse yielded from a trial batch of about 10 tons of cane.

Water of Maceration.—Measure in measuring tanks or through a water meter, applying such correction to the meter as a trial by weight might indicate, as well as a temperature correction. Or calculate from Brix of dilute juice and Brix of first mill juice to find water of dilution.

Press Cake.—Weigh a cake from each end and from the centre of a filter press daily: or weigh the entire cake from several presses daily. Great care should be taken to select fairly representative cakes and pressfuls.

Condensing Water.—The amount passed through the condensers daily should be calculated from the work of the pumps, or meter, or otherwise.

Molasses.—Weigh when shipping. Measure volume as it is obtained in the factory in tanks. Take density with hydrometer standardized against a pycnometer, making temperature correction both in measuring its volume and in taking its density.

Sugars.—Weigh in bags as packed, deducting tare weight of bags.

SAMPLING.

Cane.—Select two or more canes from each car. From the canes cut central pieces extending from the centre of one joint to the centre of the next, using equal numbers of canes cut respectively from the bottom, middle, and top of canes as they grew. These short sections, each containing one joint in its centre, are to be split with a knife and either a half or a quarter of each used.

Juice.—A continuous sample should be taken if possible. Otherwise take an hourly sample of mixed juice, and where maceration water is added take in addition a sample of the juice coming from the crusher and first mill combined. Take each hour 2 oz. of juice, putting it into a 32 oz. bottle containing about 10 gms. of anhydrous lead sub-acetate* in powder form. Take another similar sample for Brix, preserving with 8 drops of formaldehyde.

Bagasse.—Put successive handfuls from different points across the face of the last roll into a weighed can with a tightly fitting cover 500 or 1000 grams should be taken thus, twice in 24 hours.

Press Cake.—From every press samples of the cake should be taken from the middle and both ends by means of a circular cutting die 2 inches in diameter. The disks of cake should be taken from the centre and from points 4 to 6 inches from the corners.

Sugars.—Sample every two hours several bags, keeping in closed box for testing twice daily. Also take a sample from five or more bags in each strike for polarization.

Molasses.—From each strike a sample should be taken when the strike is half purged. A run sample should be prepared from a mixture of proportional parts from all the strikes of that run.

Meladura.—Take a portion from each tank or hourly samples of 2 oz. and introduce into a 32 oz. bottle containing 10 grams dry lead sub-acetate. Test every 12 hours.

Magmas.—Take a sample from each strike. If it is impossible to test all the magmas individually, make 24 hour composite samples of 100 gms. of magma from each pan, keeping different grades separate. Keep covered and mix well before analyzing.

Entrainment.—Take hourly samples of 500 cc. each of condensation water from each pan and each multiple effect. At the end of six hours evaporate 2000 gms. down to 100 gms. in a broad flat pan over a water bath and analyze. The condensing water before entering the condenser must also be examined similarly. This is an investigation only to be made when the alpha-napthol test has indicated the presence in the condensation waters of appreciable amounts of sugar.

(To be continued.)

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* **Made by the Baker and Adamson Chemical Co., Easton, Pa.**

PUBLICATIONS RECEIVED.

BEET SUGAR MANUFACTURE AND REFINING. VOL. I. EXTRACTION AND EPURATION. By Lewis S. Ware (Editor, "The Sugar Beet"). 543 pages; 262 figures. New York: John Wiley & Sons. London: Chapman & Hall, Ltd. Price, $4·00. (A review of this book will appear in our next number.)

CANE JUICE DEFECATION, 1905, by W. L. Bass, P.O. Box 773 Brooklyn, New York. Price, $3·00. This is a volume in Spanish and English similar to the author's previous work "Cane Sugar 1900," and gives details of the practice carried on by him in Dominica. It is illustrated with half-tone views of American machinery.

DIE ZUCKERPRODUKTION DER WELT, by Dr. H. Paasche. Leipzig: Verlag von B. J. Teubner. Price, 7 mk. 40. A large volume of over 300 pages, replete with information regarding the world's sugar production. Practically every sugar producing or consuming country is dealt with and details of taxes and duties levied are included.

Correspondence.

TO THE EDITOR OF "THE INTERNATIONAL SUGAR JOURNAL."

Sir,—In full accordance with the policy of caution followed by the British Delegates at the meeting of the Brussels Convention Committee, and which is referred to in your November issue, please allow me as a Cuban planter to quote a striking feature of the effect the Reciprocity Treaty between the Cuban and American Governments has had on the Cuban planters. The results have, in fact, been all to the exclusive advantage of the American trade and none to that of the Cubans.

The 20% reduction on Customs duties accorded to Cuban sugar on its entrance into the United States represents 37 cents per 100 lbs. The quotation on the London market of 8s. 1½d. is equal to $2·35 in New York and nevertheless the agents of the American Trust were offering only two cents a pound f.o.b. New York, for Cuban sugar, 96 polarization; so that the Reciprocity Treaty is annulled in its honest effects, and that is the reason why in the period of barely one week Cuban exporters have sent 6,000 tons of sugar to the United Kingdom.

Does not this fact fully justify the Cuban Government in its eagerness to draw up an Anglo-Cuban Treaty, which will save the Cuban planters from an American monopoly?

Having regard to the fact that Dr. Herzfeld in his recent paper on his journeyings in Cuba suggested that the Americans were everywhere disliked in the island, I must say that Cubans make some distinction between the United States Government, and the American people. The former enjoys the full confidence of the Cubans, the presence in it of Mr. Roosevelt being a guarantee of good faith towards the Cuban Government; but not so much can be said of all Americans connected with Cuban interests. It seems that the sound management our experienced steersman, Mr. Palma, is giving to Cuban affairs, has disappointed them in their hopes for the future. Many Cubans think that a manifest destiny may make Cuba an American dependency at a not far distant date, but they resent in a great measure many of the proceedings put into practice by American commercial men, and they are not at all sure that they will share in any of the profits arising therefrom. In short, it is true that many enlightened Cubans, who raised no objection to annexation three years ago, are now very far from desiring that consummation, however grateful they may be, as indeed they are, for the decisive help received in the struggle for independence.

Yours faithfully,

C. PLANTER.

MONTHLY LIST OF PATENTS.

Communicated by Mr. W. P. THOMPSON, C.E., F.C.S., M.I.M.E., Chartered Patent Agent, 6, Lord Street, Liverpool; and 322, High Holborn, London.

ENGLISH.—APPLICATION.

22709. A. CLASSEN, London. *Process for facilitating the fermentation of sugar solutions obtained from wood that contains tannin.* (Date applied for under Patents Act, 1901, 21st November, 1904, being date of application in Germany.) (Complete specification.) 6th November, 1905.

ABRIDGMENT.

10273. H. ROY, Paris, France. *Improvements in or relating to the treatment of masse-cuite and in apparatus therefor.* 16th May, 1905. This invention relates to a continuously working apparatus for draining or filtering masse-cuite in which the material is introduced at the bottom and passes upwards in a casing provided with a sieve and with a stirring and scraper blade, a vacuum space being provided between the outer surface of the sieve and the inner surface of the casing.

GERMAN.—ABRIDGMENTS.

162699. HERMANN SCHÄFER, of Cologne, Riehl. *A centrifugal machine having several centrifugal chambers.* April 5th, 1903. (Patent of Addition to Patent No. 153081, of January 1st, 1903.) This centrifugal machine having several centrifugal chambers is an improvement on Patent No. 153081, and its principal feature is that the movable closing wall of each centrifugal chamber is held closed automatically by reason of centrifugal force by means of a sliding bolt or a bolt having the action of a lever.

163443. Dr. GEORG KASSNER, of Münster, Westphalia. *A process for separating raw sugar from watery solutions, vegetable juices, molasses and the like.* 20th September, 1904. The principal feature of this process is the simultaneous use of calcium sulphate and calcium oxide or calcium hydrate with the object of converting raw sugar into a chemical compound (which is with difficulty soluble) with calcium sulphate and calcium oxide, the calcium sulphate being added either in the pulverulent condition or being produced in the mixture itself by known methods of conversion.

163445. HALLESCHE MASCHINENFABRIK & EISENGIESSEREI formerly R. RIEDEL & KEMNITZ, of Halle-on-Saale. *An apparatus for regulating the circulation of fluid in an evaporating and boiling apparatus having heating bodies arranged in tiers.* 4th March, 1905. (Patent of Addition to Patent No. 147916, of January 30th, 1903.) This is an improvement on the apparatus described in Patent No. 147916, and its object is to regulate the circulation of the fluid in evaporating and boiling apparatus having heating bodies constructed in tiers. Its principal feature is that the annular parts of the heating bodies are separated into two or more super-imposed pieces through the intervals between which the substance or solution can pass when the level of the liquid has not yet reached the highest edge of the ring of a heating body.

163833. ALPHONSE HUILLARD, of Suresnes, France. *A drying apparatus for doughy, pasty or fluid substances.* 4th September, 1904. In this drying apparatus for pasty or fluid substances in which the material is received by an endless wire-gauze belt and conveyed through an apparatus for removing the dried material, the principal feature consists in the belt being composed of inter-twisted spiral wires.

164364. BERNHARD HOFFBAUR, of Cologne-on-Rhine. *Drying apparatus.* October 16th, 1903. (Patent of Addition to Patent No. 160744, June 23rd, 1903.) This is an improved form of construction of the drying apparatus described in the original Patent No. 160774 and the principal feature consists in a drying shield by being immersed in the material to be dried forms two chambers in the upper part of the trough in such a way that the water-saturated dustless part is directly conveyed for preliminary drying to the chimney flues, whilst the dusty part at the final drying must first pass through the preliminarily dried material with the object of saturating it with water and retaining the dust, whilst excluding any condensing action.

164396. Dr. H. R. LANGEN, of Cologne-on-Rhine. *Process for obtaining sugar from expressed beetroot shreddings.* 30th December, 1903. This method of obtaining sugar from expressed beetroot shreddings with a juice of high degree of purity is characterized by the pressed shreddings being mashed with dilute sugar juice of low purity and then again pressed.

164486. HEINE BROS., of Viersen, Rhine Province. *Centrifugal machine in which a heating or cooling medium acts on the material centrifugalled in the drum or on its walls.* 20th March, 1904. This improved arrangement of the centrifugal is characterized by the place for discharging the heating or cooling medium being connected by a return pipe with the feed pipe for the same, which discharges into the centrifugal drum in such a way that the medium returning into the latter is lifted by the rotating centrifugal drum itself.

164539. W. BOCK, of Prinzenthal, near Bromberg. *A vertically displaceable closing piece for shreddings presses for extending or shortening the press chamber whilst avoiding altering its section.* April 4th, 1905. (Patent of Addition to Patent No. 147673, of December 2nd, 1902.) This is an improvement on the closing piece for shreddings presses described in the principal Patent No. 147673, and is characterized by the closing piece no longer engaging over the lower cylindrical part of the spindle, but the annularly formed lower cylindrical part of the cylinder enclosing the cylindrical part of the closing piece.

NOTE.—Copies of all published specifications with their drawings in these lists can be obtained from W. P. Thompson & Co., 6, Lord Street, Liverpool, at One Shilling a copy for English or American Patents, and Two Shillings for German. In ordering please give number and date.

Patentees of Inventions connected with the production, manufacture and refining of sugar will find *The International Sugar Journal* the best medium for their advertisements.

The International Sugar Journal has a wide circulation among planters and manufacturers in all sugar-producing countries, as well as among refiners, merchants, commission agents, and brokers, interested in the trade, at home and abroad.

IMPORTS AND EXPORTS OF SUGAR (UNITED KINGDOM)

To end of November, 1904 and 1905.

IMPORTS.

Raw Sugars.	Quantities.		Values.	
	1904. Cwts.	1905. Cwts.	1904. £	1905. £
Germany	5,863,562	4,914,267	2,815,034	2,709,561
Holland	699,148	194,547	381,719	109,806
Belgium	843,773	848,933	453,303	467,428
France	496,137	676,005	262,241	357,147
Austria-Hungary	699,203	380,585	317,940	247,906
Java	1,869,074	2,377,981	911,112	1,515,695
Philippine Islands	87,025	9,023	31,165	4,840
Cuba	....	....	....	....
Peru	922,845	1,113,642	440,775	711,843
Brazil	84,257	126,494	32,295	62,486
Argentine Republic	....	....	....	....
Mauritius	524,999	167,007	198,838	91,001
British East Indies	79,323	256,180	30,116	143,662
Straits Settlements	122,536	193,126	52,072	102,945
Br. W. Indies, Guiana, &c.	913,331	1,066,066	602,922	830,243
Other Countries	489,717	761,276	241,791	507,013
Total Raw Sugars	13,699,930	13,085,132	6,771,323	7,861,576
Refined Sugars.				
Germany	9,643,909	8,723,676	5,640,381	6,702,214
Holland	2,956,474	1,610,969	1,835,318	1,257,802
Belgium	504,801	289,194	304,068	217,057
France	2,572,513	2,235,149	1,507,312	1,556,250
Other Countries	180,400	345,778	95,785	283,604
Total Refined Sugars	15,858,097	13,204,766	9,382,864	10,016,927
Molasses	1,700,682	2,386,778	313,280	471,096
Total Imports	31,258,709	28,676,676	16,467,467	18,349,599

EXPORTS.

British Refined Sugars.	Cwts.	Cwts.	£	£
Sweden	2,520	1,053	1,025	500
Norway	29,546	19,526	16,790	14,276
Denmark	98,826	81,839	51,289	55,656
Holland	62,939	77,717	35,688	58,037
Belgium	10,157	9,345	5,605	5,807
Portugal, Azores, &c.	17,353	15,973	9,662	10,937
Italy	4,258	15,388	2,145	9,131
Other Countries	323,746	354,474	214,507	292,207
	549,345	575,315	336,711	446,551
Foreign & Colonial Sugars.				
Refined and Candy	22.761	22.412	16,020	19,097
Unrefined	96,965	95,616	54,422	64,087
Molasses	2,319	2,763	1,219	848
Total Exports	671,390	696,106	408,372	530,583

UNITED STATES.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1905. Tons.		1904. Tons.
Total Receipts, Jan. 1st to Dec. 21st ..	1,850,939	..	1,894,535
Receipts of Refined ,, ,, ,, ..	1,533	..	569
Deliveries ,, ,, ,, ..	1,781,139	..	1,906,696
Consumption (4 Ports, Exports deducted) since January 1st	1,747,650	..	1,854,107
Importers' Stocks December 20th.. ..	69,800	..	none.
Stocks in Cuba, December 20th	37,000	..	12,500
Total Stocks, ,, ...	176,000	..	97,260
	1904.		1903.
Total Consumption for twelve months ..	2,767,162	..	2,549,643

CUBA.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1904 AND 1905.

(Tons of 2,240lbs.)	1904. Tons.		1905. Tons.
Exports	1,090,061	..	1,044,430
Stocks	682	..	73,668
	1,090,743	..	1,118,098
Local Consumption (twelve months)	44,320	..	45,160
	1,135,063	..	1,163,258
Stock on 1st January (old crop)	94,835	..	——
Total Production..	1,040,228	..	1,163,258

Havana, November 30th, 1905.

J. GUMA.—F. MEJER.

UNITED KINGDOM.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION FOR ELEVEN MONTHS ENDING NOVEMBER 30TH.

SUGAR.	IMPORTS. 1903. Tons.	IMPORTS. 1904. Tons.	IMPORTS. 1905. Tons.	EXPORTS (Foreign). 1903. Tons.	EXPORTS (Foreign). 1904. Tons.	EXPORTS (Foreign). 1905. Tons.
Refined	857,220	792,905	660,238	2,021	1,138	1,121
Raw	571,387	684.996	654,256	2,802	4,848	4,781
Molasses	75,502	85,034	119,339	94	116	138
Total..........	1,504,109	1,562,935	1,433,833	4,917	6,102	6,010

	HOME CONSUMPTION. 1903. Tons.	HOME CONSUMPTION. 1904. Tons.	HOME CONSUMPTION. 1905. Tons.
Refined	807,975	800,643	660,098
Refined (in Bond) in the United Kingdom	48,309	490,854	512,337
Raw	411,900	114,596	94,211
Molasses	72,384	78,491	111,890
Molasses, manufactured (in Bond) in U.K.	8,161	55,944	51,758
Total	1,348,729	1,540,528	1,430,294
Less Exports of British Refined....................	49,201	27,467	28,766
Total Home Consumption of Sugar	1,299.528	1,513,061	1,401,528

Stocks of Sugar in Europe at uneven dates, Dec. 1st to 20th, compared with previous Years.

In thousands of tons, to the nearest thousand.

Great Britain.	Germany including Hamburg.	France.	Austria.	Holland and Belgium.	TOTAL 1905.
124	1266	734	704	260	3090

	1904.	1903.	1902.	1901.
Totals	2711 ..	3297 ..	3062 ..	2870

Twelve Months' Consumption of Sugar in Europe for Three Years, ending November 30th, in thousands of tons.

(Licht's Circular.)

Great Britain.	Germany.	France.	Austria.	Holland, Belgium, &c.	Total 1904-5.	Total 1903-4.	Total 1902-3.
1591	928	589	475	166	3748	4210	3726

Estimated Crop of Beetroot Sugar on the Continent of Europe for the current Campaign, compared with the actual crop of the three previous Campaigns.

(From Licht's Monthly Circular.)

	1905-1906. Tons.	1904-1905. Tons.	1903-1904. Tons.	1902-1903. Tons.
Germany	2,375,000 ..	1,598,164 ..	1,927,681 ..	1,762,461
Austria	1,460,000 ..	889,373 ..	1,167,959 ..	1,057,692
France	1,075,000 ..	622,422 ..	804,308 ..	833,210
Russia	1,020,000 ..	950,000 ..	1,206,907 ..	1,256,311
Belgium	325,000 ..	176,466 ..	203,446 ..	224,090
Holland	200,000 ..	136,551 ..	123,551 ..	102,411
Other Countries .	420,000 ..	340,000 ..	441,116 ..	325,082
	6,875,000	4,712,976	5,874,968	5,561,257

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☞ The Editor is not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

NOTES AND COMMENTS.

The General Election 1906.

A month ago the most sanguine optimists would never have prophesied that at the General Election a sweeping change would take place to a degree practically unparalleled in modern history. It was thought that the Liberals would be lucky if they captured as many as 100 seats. But within one short fortnight a political revolution has occurred. The ex-Prime Minister and the majority of his colleagues in the late Government have been unseated by large majorities; and as for the rank and file, they have been disastrously routed, so much so that at the time of writing the Liberals have a majority of some fifty over Unionists, Irish and Labour combined. The one bright spot in this disastrous election has been the return of Mr. Joseph Chamberlain and his Birmingham fellow-members by greatly enhanced majorities.

Into the causes which have led to this overwhelming defeat of the once powerful Unionist party, we do not just now propose to enter. The turmoil of the election is not yet over, and the careful observer must advisedly hold over his verdict till quiet is once more restored and a sane opinion, based on a consideration of all the influences that have been exerted, can be formed. For it is clear that exceptional as has been the course of the elections, no less exceptional have been the number and character of the cross-currents which have gone to confuse the main issue. It was the misfortune of the Unionists that the majority of these cross-currents all converged to oppose them. The Education Act (as regards Religious Teaching), Chinese Labour in the Transvaal, Free Trade, the Labour vote, and such like have all tended to influence the electors; but the outcome of it all is that a Liberal Free Trade Government is not only in office, but also in power of exceptional proportions, and will be able to make or mar the prosperity of the British Empire for some years to come.

Memorial to James Duncan.

We are glad to learn that there is a movement on foot to erect a memorial to the late Mr. James Duncan, a tribute to whose memory appeared in our December issue. It is proposed that this should take the form of a memorial fountain to be erected at Kilmun, where at one time he lived. The then manager of his Greeneck refinery, Mr. B. E. R. Newlands, now of 2, St. Dunstan's Hill, London, E.C., is among the gentlemen who are interested in the scheme, and he will be glad to receive contributions from any who have had the good fortune to know or come into contact with the late Mr. Duncan. We may add that so far over £40 has been subscribed.

Confectionery Profits.

In the *Chamber of Commerce Journal* for January, there was an account of the Confectionery trade in London during the 11 months ending November last. In this it was stated that the quantity and value of the exports of confectionery, jams and preserved fruits was higher last year than either of its predecessors. Here are the figures given for the past three years:—

	Cwts.	£.
1905	315,478	824,221
1904	289,841	750,870
1903	294,886	743,718

It also states, "Moreover, what is more satisfactory still, there is "no doubt there is even greater improvement in the home trade," and further in the report we read that "during the first five months, Confectioners were not free from anxiety owing to the high price of "sugar, but happily the collapse of those high prices, *which were "mainly caused by the excessive speculation*,* came sooner and more "completely than many people anticipated."

It will appear to most of our readers that this is a complete answer to all the misrepresentations that have been issued as to the injury to the confectionery trade through the abolition of bounties, and we hope that now no more will be heard of "weeping and lamentation" in the confectionery quarters.

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*The Italics are ours [Ed. *I.S.J.*]

The Sugar Industry in St. Croix.

Some particulars appeared in a recent number of an American contemporary on St. Croix's sugar industry. The past season's crop has been a poor one owing to the drought, and only reached a total of between seven and eight thousand tons. The supervision of the Central factory has been taken over by a large Danish sugar company, and under this change of management, important improvements have been introduced. This factory has several stations where the canes are crushed, and one of them was recently fitted with a nine-roller mill and Krajewski Crusher, driven by four engines. But another station is being fitted with a nine-roller mill and crusher, driven by only one Corliss engine. All this machinery is from the Mirrlees Watson Company of Glasgow. The Bethlehem factory was erected during 1904 and the beginning of 1905, and made its first crop last season. Messrs Breitfeld, Danek and Co., of Prague, were responsible for the machinery, which is stated to be remarkably well finished. St. Croix is said to be the most pushing island in the West Indies, and we only wish Barbados would follow its example.

BRAZIL AND THE BRUSSELS COMMISSION.

The *Demerara Daily Chronicle* of the 5th December, 1905, devotes nearly two columns to this subject. We desire that our readers in the West Indies should clearly understand the question, and, therefore, we venture to give the following reply to our contemporary's strictures on the general policy pursued by the British Delegates in regard to the penal clause of the Convention.

The limitation of the surtax to 6 francs per 100 kilos. refers only to the contracting parties. With regard to countries outside the Convention, the engagement is to penalize "sugars coming from countries *which give bounties* on production or exportation." If advantages should be found "*eventually to result* from the surtax specified in line *f* of Article I." then a rule is laid down for calculating the countervailing duty. It is perfectly clear from these quotations that we are bound to prove that an actual bounty is given, or that an advantage equivalent to a bounty arises from an excessive surtax. That is the position taken up by the British Government and successfully carried out in spite of contrary views held by other Delegates. It is clearly the right and only just policy to be pursued under the terms of the Convention. To condemn every country to be penalized which had a surtax exceeding 6 francs, without at the same time proving that such surtax operated as a bounty on exportation, would be such a gross injustice that it would at once bring the Convention into contempt and give its opponents good cause for complaint and for demanding that it should be denounced.

There is no parallel between Russia and Brazil. The Russian surtax is created not only for the purpose of protecting the industry from outside competition, but with the definite and deliberate intention of raising prices for home consumption far above the world's price. This has repeatedly been shown to operate as an enormous bounty on exportation, enabling Russian sugar to be exported below cost price, and yet leaving the Russian producer with a large profit on his total production. If the same can be proved with regard to Brazil, that country will most assuredly, and with very good cause, be penalized; but if not, it would be entirely contrary to the spirit and the letter of the Convention to perpetrate such an injustice. Such action would at once condemn the Convention as an economic failure, instead of being, as M. Yves Guyot has most truly declared, "The most important achievement of economic liberal policy in Europe since the signing of the Commercial Treaties of 1860."

The *Demerara Chronicle* deplores the fact that so far the Convention "has done so little to steady prices and stiffen the market." The answer is very simple—we are still suffering the after-effects of the bounties. Those bounties have built up during the last thirty years a vast sugar industry on the Continent of Europe which is now capable, when working full in a good season, of producing nearly 7,000,000 tons out of a total visible world's production and consumption of about 10,000,000 tons. If events had followed their ordinary course after the Convention came into force production would have gradually re-arranged itself in accordance with natural laws governed only by cost of production. But unfortunately an accident happened on a very large scale. A severe drought reduced the European beetroot crop from 5,700,000 tons to 4,600,000, a great speculation set in, prices were forced up from 8s. to 16s. per cwt. for raw beetroot sugar, and the industry immediately sowed the largest acreage on record. The consequence is that instead of a re-adjustment of production on the basis of the survival of the fittest—those who can produce at least cost—we have to face a repetition of the old artificial state of things, namely, an excessive production of beetroot sugar. If the bounties had not made us dependent on the beetroot crop for our supply this would not have happened. The writer says: "Had the disastrous re-action of the past seven or eight months occurred prior to the operation of the Convention, what an argument it would have furnished for those who sought the suppression of the bounties!" Quite so, but he ignores the fact that the sugar production of the world was still in the position created under the bounty régime; the beetroot industry saw the price of 16s. and naturally sowed a bumper crop. That very action was enough to cause the subsequent fall to 8s., apart from reduced consumption and the usual slump when speculators try to get out. The whole "disastrous re-action" is merely a repetition of many others, all the result of bounties causing over-production, followed by reduced competition and a step nearer to the monopoly of the market by the European beetroot industry. Many of them were far more severe than the present one. In 1889 prices rose from 10s. to 28s., natural production having received a severe blow, and then went back to 10s.

As the late Lord Farrer truly said, the effect of bounties is "Glut, collapse, and ruin." We are still suffering that effect; but this time the beetroot industry are among the sufferers.

MULTIPLE-ROLLER MILLS.

In our *Notes and Comments* last month we had occasion to refer to a new and up-to-date plant which Messrs. George Fletcher & Co., of Derby, had recently sent out to Berbice. We are now enabled to supply some further particulars.

As already mentioned, the plant consists of a five-roller mill, with provision on the bedplate for two additional three-roller mills to be erected later on. This will then form an eleven-roller mill, driven by one engine, which should prove superior to any nine-roller American mill. The whole plant was built to the order of Booker Bros., McConnell & Co., Ltd., of London, Liverpool and Demerara, for their plantation, Port Mourant, Berbice, British Guiana. First come two Krajewski Crushers, to which the cane is brought on an endless band from the punts. These crushers are fitted with stout spiral springs, whereas the main rollers have rigid bearings. The former are driven from the engine through three sets of gear wheels, and are themselves geared together, as are likewise the main crushing rollers, which are 34 in. in diameter and 72 in. long. The top roller is driven from the engine through two sets of reduction gear. The main mill is fed by a reciprocating fork.

It is not intended for the present to fit the two further three-roller mills; instead, an existing three-roller mill will be placed in position. The megass, on leaving the first mill, will fall into a hot macerating tank, and thence will be conveyed by a travelling band to the second mill.

The engine, which is amply powerful enough to drive eleven rollers, is of the single cylinder horizontal type. It is designed for a steam pressure of 120 lb., and has a cylinder 32 in. diameter by 60 in. stroke, and a piston speed of 460 ft. per minute. A piston valve and link motion reversing gear are fitted. The last mentioned detail is necessary in case the mill jambs, as, in that event, reversing the mill will in all probability free the rollers. The engine flywheel is naturally of massive proportions, weighing no less than 17 tons.

We are glad to see a thoroughly up-to-date British mill is being sent to Demerara, and we have no doubt it will prove superior to any

American design existing out there. We have been taken to task for expressing the opinion a year or two ago that British engineers were getting behind their American confrères in multiple mill construction. We no longer think this is so; but we see no reason for supposing that at that time we were wrong in the opinion we then expressed. The evidence was pretty conclusive in pointing to the fact that while in theory perhaps British manufacturers could turn out what was wanted, yet in practice they were not so ready either to advertise or to produce a satisfactory multiple roll mill as were their American rivals. Hence it came to pass that an order given by a British firm for their Demerara factory went to America, because they came, rightly or wrongly, to the conclusion that nothing corresponding to their requirements could be got in this country. We contend that they should not have been allowed to think so; but to all appearance the clever booming of the American mill had not produced sufficient activity on the part of our manufacturers as to counteract its catching on. A cursory inspection of the advertisements of British firms did not suggest that they had nine or twelve roller mills "in their shop window." But things have improved since then. Our manufacturers have waked up, and have secured some very fine orders of late, of which the above mentioned plant is an example. We can only congratulate them, and hope they will continue to secure their due.

OBSERVATIONS ON THE CULTIVATION OF THE SUGAR CANE.

By Leon Pellet.

We have read with a considerable interest the article published by Mr. Eckart on the different varieties of canes in various countries.

The following remarks of his are of particular interest:—

"Climate and soil are the paramount influences exerted on the sugar producing capacity of different varieties, and of these two conditions it is difficult at times to note which has the more determining effect on crop production."

We would like to make some observations on this subject.

Of these two paramount influences we propose first to examine that of the soil.

In every country where one or more Experiment Stations exist, the trials of the different varieties of canes are carried out so as to solve certain predetermined problems, among which we should note:—

1. For the *ordinary conditions of cultivation* in the country, which is the best variety?

2. Which are the best physical and chemical conditions of the ground for the maximum crop, weight and sucrose content?

3. Which are the best physical and chemical methods to use so that the soils of the country shall give the maximum yield?

It is chiefly the second which is the most studied. It is the most scientific and demands a great number of tests, the leading idea of all these tests being as follows:—

The experiment fields contain a soil of a definite physical and chemical composition (which may or may not be an average of the general soil of the country): from the results already obtained we decide to change the physical and chemical conditions so as to reap the maximum possible crop.

Therefore, the question is: In the actual state of our knowledge what would be an ideal composition of the soil?

This question has, it is true, been already settled in the different countries and many articles been published on the subject, but we believe that it would be very useful and interesting to get up a review and to have the actual opinion of the main body of sugar cane workers.

Naturally the physical and chemical conditions will be different in consequence of the varying climatic conditions, but they will remain perfectly comparable among themselves.

In short, we would suggest that the agriculturist is the dominating factor of the influence of the soil.

The examination of the influence of the climate is more uncertain; the climatic conditions differ so enormously in the various countries where the sugar cane is grown. But we have as a guide in our comparisons two principal lines.

1. The amount of heat received by the cane.

This figure is obtained by adding up the mean day-temperatures during the whole period of vegetation.

For example, if the mean day-temperature is 22° C. and if the vegetation lasts twelve months (360 days), the total amount of heat received will be 7,920° C.

Naturally this number differs greatly in each country. It will be 11,000 in the Hawaiian Islands and 6,000 in Spain or Egypt.

2. The changes in temperature during the day and night, and during the different seasons.

This factor is of the greatest importance, because in some countries the frost in winter is as bad for the cane as the extreme heat in summer. Certainly the ideal weather for this purpose is met with in the Hawaiian Islands. It is, however, easy to understand that the mean day-temperature might be the same in two countries and yet not give the same results.

If one takes into account these two factors, it is possible to state a proportionality between the heat received and the quantity of sugar produced, and in that case, all the results of the tests carried out in different countries will become much more capable of comparison.

SIMPLE METHODS OF CHEMICAL CONTROL.

By T. H. P. Heriot, F.C.S.

(Continued from page 26.)

VIII.

The Control of the Mill.

We commenced these articles by stating what the factory manager or overseer might attempt in the direction of chemical control, and we advise the reader to refer to Chapter I. for particulars regarding the scope of the enquiry upon which we now propose to enter.

The old three-roller mill is so defective an appliance for extracting juice that the loss of sugar in the megass generally exceeds all other losses put together. Modern methods of extraction aim at supplementing the action of the mill by washing the megass with water, but as such improvements can only be successfully used in factories where chemical control is adopted, they do not come within the scope of the present papers.

"Dry crushing" is adopted in the majority of cane sugar factories, although the best constructed mill of this type extracts only a moderate percentage of the total juice in the cane. In Chapter I. we referred to this loss as *unavoidable* in order to distinguish it from those which are due to negligence, and, consequently, of more immediate importance.

The basis of our simple methods of control will be the weight of sugar entering the factory in the form of juice. Consequently, the the sugar left in the megass will be excluded from our reckonings. As the quantity of sugar in the megass cannot be arrived at without the chemist's assistance, all that can be done in the direction of controlling the extraction is to detect *avoidable* losses, or such as are due to careless work. In other words, we propose that such general indications as are afforded by the appearance and "feel" of the megass should be supplemented by a simple test, the results of which can be expressed numerically.

The percentage of moisture in megass, as ascertained by drying a weighed quantity, will serve our purpose admirably, because, in the case of "dry crushing," this moisture is due to unextracted juice, of which water is the chief constituent; and, therefore, serves as an indirect measure of the sugar lost.

Sampling.—The main difficulty lies in the fact that the megass is not of uniform composition; the larger fragments being richer in juice than the more disintegrated portions. In order that the coarse and fine megass shall be duly represented, it is therefore necessary to collect a sample weighing about ten pounds. If only a portion of this sample is to be dried it becomes necessary to cut up the larger pieces so that the whole sample may be subsequently mixed, but as this course involves much labour and is open to the objection that the megass loses moisture on exposure to the air, we prefer to dry the ten pound sample as it stands and to construct some special apparatus for this purpose (see Chapter II.).

Assuming the wire cages to have been previously tared and numbered, duplicate samples should be collected in two of the cages as follows:—

(*a*) If the megass is conveyed from the mill by an elevator, a "paddle-load" of megass is withdrawn and divided between the two cages. Instead of attempting to sample every paddle of the elevator it is preferable to allow two or three to pass for every one that is emptied. This is continued until the two cages are filled.

(*b*) In the absence of an elevator, the megass is usually removed from the mill on canvas stretchers, which are filled directly from the mill. If a handful from each of these loads be dropped into each cage, the latter will contain fairly representative samples when filled.

Weighing.—The gross weight of each cage may then be ascertained by means of the balance, and, deducting the tare, the weight of megass taken. But, as odd weights complicate the subsequent calculation, we prefer to adjust the gross weight to exactly ten pounds plus the tare, by adding or removing megass. The advantage of so weighting the empty cages that the tare is the same for each, will be evident. As the cages have to be dried in another part of the factory, it economizes time to re-weigh them near the drying chamber. With this object, two iron brackets are provided for suspending the spring-balance; one of which should be screwed to an upright near the mill, at a height of about five feet from the floor, and the other to a suitable upright near the drying chamber.

Drying.—The wooden chamber described and illustrated in Chapter II. is a temporary arrangement which, being portable, enables us to ascertain the most suitable position for erecting a permanent brick chamber of the same internal dimensions.

The cages, with their lids attached, are now placed horizontally in the positions shown in *Fig. 3* (Chapter II.), a clearance of 6 inches being left between the furnace-wall and the nearest cage. The drying will then proceed without further attention.

Re-weighing.—The megass should be perfectly dry in from 10 to 16 hours, but the cages may remain in the drying chamber until it is convenient to re-weigh them. If this is done within 12 hours, the cages should be returned to the drying chamber and re-weighed after an additional 3 or 4 hours, in order to make sure that there is no further loss of weight. As both cages were filled with the same megass, the final loss should be the same in each case.

Precautions.—Should portions of the megass become blackened during drying, it will be impossible to obtain a constant weight, and the loss will be in excess of the true moisture. A slight brown colour may be ignored if no appreciable loss in weight occurs on re-heating for 2 or 3 hours. As this risk is greatest in the case of the cage lying nearest to the furnace-wall, we recommend that the first 2 or 3 tests should be made in duplicate, so that this possible defect of our home-made apparatus may be detected. It is also important to remember that the brickwork chamber will be somewhat hotter than the wooden model.

Calculations.—The result of the test should be recorded, along with a few general observations, as in the following example:—

January 20th, 1906, 8 a.m.—Bourbon Canes.
Feed to mill: Heavy and fairly regular.
Megass: Well crushed and moderately dry.

			lbs.	*oz.*
Cage No. 1.	*+ 10lbs. megass*	=	*14*	*3*
	After drying		*8*	*10½*
			5	*8½ or 5·53lbs.*

Moisture = *55·3%*

The corresponding loss of sugar may be approximately calculated from the per cent. moisture by assuming that the ratio of water to sugar in the residual juice of the megass is the same as in the bulk of the juice expressed by the mill. Juice containing 14% of sugar and of density 17·5° Brix will contain 100 — 17·5 = 82·5% water, and the ratio of water to sugar is nearly 6 : 1. Applying this ratio to the above percentage of water in the megass, we obtain $\frac{55·3}{6} = 9·2\%$ of sugar in the megass.

It is customary to express this loss on 100 parts of canes ground, in which case the latter must be weighed, and the percentage by weight of extracted juice ascertained as under "Extraction" in the following chapter. This percentage being about 65 in the case of good single crushing, the remaining 35% represents the megass (containing 9·2% sugar) and 35% of 9·2 = 3·2 tons of sugar lost per 100 tons of canes ground. As these 100 tons of cane will contain 12·4 tons of sugar, it follows that for every 9 tons of sugar extracted there is a loss of over 3 tons, or about 27% of the total sugar.

It is, indeed, strange how a sugar factory, where such prodigal waste occurs, can yield a profit. As these figures are typical of *good single crushing*, the loss is not due to negligence, but to the fact that cane factories are generally on too small a scale to profit by the introduction of modern milling machinery and new methods of extraction.

To return to the example quoted above, this result is good for a three-roller mill. Should the moisture amount to, or exceed, 60%, this will indicate bad work due either to the imperfect adjustment of the mill, or to the smallness or irregularity of the feed. With good double crushing, the moisture should not much exceed 50%, so that in this case 55% would indicate very inferior work. The limits between good and bad work cannot be exactly defined, because the moisture in the megass is influenced by the juiciness of the canes and the quality of the fibre. But starting with the above data as approximately true, the test should be applied whenever the appearance of the megass invites suspicion. This must, however, be done methodically if sound conclusions are to be drawn from the results, and we propose the following series of

Experiments.—When the preliminary tests give duplicate results agreeing within 0·5%, a series of daily tests should be commenced and continued for a week with the object of ascertaining what percentage of moisture is left in the megass under normal working conditions. The average of the six results will be only approximately true, because we have no *proof* that the samples of megass *were* collected under normal working conditions; in fact, the daily differences tend to prove the contrary. The only safe conclusion to be drawn is that the *normal moisture* varies within the extreme limits found.

Should the result appear satisfactory when compared with the data given above, this does not prove that a better extraction is impossible. As a matter of fact, very few mills are run at their maximum power, and we are inclined to agree with the attorney who said that it was the duty of every factory manager to break a roller or two in taking off a crop. At any rate, spare rollers are as essential to good milling as is the fly-wheel to the mill engine.

No breakdown need be feared in carrying out the next experiment. Ascertain the approximate depth of the feed entering the mill under normal working conditions and attach an upright to the side of the cane-carrier which will indicate the uppermost level of the cane when the feed is increased to the extent of half its normal size. Having previously provided a good supply of canes (cut from the same field, if possible), these are fed to the mill in the ordinary way and a fair sample of the megass collected in one of the cages. This having been done, the feed is gradually increased. When the level of the feed has reached the marked point, it is to be maintained as uniform as possible whilst a second cage is gradually filled with a sample of the megass; the general appearance of the megass being also noted. The feed can now be reduced, and the normal working conditions resumed. A difference between the two samples of 2% of moisture may be expected, and this will represent a temporary gain of about 400 pounds of dry sugar for every ton of canes ground. In many factories the depth of the feed might be doubled, or even trebled, with advantage, but as a regular and continuous feed is the main essential, any such increase must be permanent to be effective.

When an increased daily supply of canes cannot be relied upon, or when the factory cannot handle an increased output of juice, an improved extraction may be obtained by attention to the mill itself, and here the advice of an experienced engineer is necessary. Each mill must be adjusted to suit local conditions, and a knowledge of the per cent. moisture in the megass will serve as a guide to the engineer.

An unavoidable defect of all mills lies in the practical impossibility of so distributing the feed that the pressure exerted by the rollers is equal at different points. As a rule, more cane (or megass) passes through the centre of the mill than on either side, so that frequently long pieces of partially crushed cane are seen emerging from the extremities of the rollers whilst well pulverized megass passes from the central area. Our last experiment is designed to prove this defect when it is otherwise not apparent.

Let the megass fall direct from the mill into three cages, one of which is held centrally and the other two on either side of the megass-chute. The three cages are thus filled simultaneously with megass obtained from the same canes. Even if the feed has been very carefully distributed the two outside cages will generally show a greater loss in weight on drying than the central cage. This experiment should be repeated when no effort has been made to distribute the feed entering the mill.

In a later chapter it will be shown how our home-made apparatus may be of service in testing the fuel value of the megass.

(To be continued.)

During 1904 Cuba had, according to an American publication, 174 plantations which were owned, 69 by Cubans, 64 by Spaniards, 24 by Americans, 9 by British, 7 by French, and 1 by Germans.

The West Indian sugar exporters are anxious that the Canadian tariff, wherein sugars under 16 D.S. pay only about half what sugars over that standard pay, shall be amended so as to make 19 or 20 D.S. the dividing line. This would enable semi-refined sugars, such as the West Indies largely produce, to be admitted into Canada at a lower rate of duty. At present they are practically excluded. The attention of the Canadian Tariff Commissioners has been drawn to this.

THE REVIVAL OF THE SUGAR MACHINERY INDUSTRY IN GLASGOW.

The opinion expressed this time last year as to the expected improvement in the exportation of sugar machinery, for which Glasgow has a world wide reputation, has been fully borne out. Owing to the high price of sugar in the early part of the year, all those planters who were wise enough to sell their sugar immediately it was made, reaped handsome profits, which put them in funds to improve and extend their plant. A large number of orders were placed for new mills, also for recrushing mills, by planters in Cuba, and the bulk of these orders came to Glasgow.

During the past year a number of new complete central sugar factories have been shipped from Glasgow for British India, also for Natal and Japan, and further orders are in hands for sugar factories and refineries for various parts of the world.

The Harvey Engineering Co., Ltd. (late McOnie, Harvey & Co., Ltd.) have been fully employed during the year, being busy with the usual number of repairs and some extensions for their clients in the West Indies, Peru, Java and Cuba. Last year they erected the first Patent Naudet Process Plant in the West Indies, which worked through the whole crop and gave a result ahead of the work done by the ordinary mills during the previous year, and this plant has been extended and improved so that a still better result is looked for in the coming crop. They have also shipped during the year a large number of their Harvey Patent Evaporators, and have now over ninety evaporators at work, which shows the high place this apparatus holds in the opinion of sugar planters throughout the world.

However, the bulk of their work has been the erection of complete central sugar factories, and during the past year they have shipped three complete factories, and have still in hand another complete sugar factory, also a complete sugar refinery for abroad, which is ample proof that there is a decided revival of the sugar machinery industry in Glasgow.

Another big firm, the Mirrlees Watson Co., have had a busy year. In the early spring, orders from Cuba began to arrive rapidly. These included seven exceptionally heavy cane crushing plants, a crystallization in motion apparatus for one of the largest factories in the island, and vacuum pumps and numerous sundries. To Jamaica, where efforts are being made to improve the sugar industry, some new triple effets have been dispatched. In the most important sugar-producing districts of Mexico, British machinery predominates, most of it coming from Glasgow, and, as usual, a number of large and small crushing plants have been supplied during the past year. Orders have also been received from Nicaragua, Argentina, Natal, Straits Settlements, and last but not least from Fiji, where a huge central factory is being constructed.

The prospect for the coming year is not so good, owing to the present very low prices of sugar caused by the over-production of beet sugar on the Continent, but as this over-production must be sold at a loss, and as cane sugar can now be produced at a much lower price than beet sugar, the amount of cane sugar in the world's consumption must naturally increase, and the beet sugar decrease, and then the demand for cane sugar must continue, and add to the prosperity of this special branch of engineering in Glasgow.

THE CONSTITUTION OF JAVA CANE SUGAR MOLASSES.

By H. C. Prinsen Geerligs.

Director of the West Java Sugar Experiment Station at Pekalongan (Java).

(Continued from page 35.)

The figures from the tables give rise to the following remarks and observations:—

Degrees Brix and Actual Dry Substance.

Among the molasses analysed there are a few so liquid that they must surely have been subsequently diluted with water, numbers 30, 48, 49, 66, and 77, and of these the numbers 49 and 77 to such a degree that a part of the saccharose has become inverted by fermentation, rendering the determination of saccharose, quotient of purity and those figures derived therefrom quite useless. The numbers quoted here cannot be considered as belonging to saturated solutions, and will remain unmentioned in so far as the sugar, glucose, and moisture contents are considered. The figures for the ash, gummy matter, and the elements of the ash maintain their value, and it is for this reason that these molasses are entered in the tables, only the doubtful figures being omitted. Everybody knows that the figure for the degrees Brix is always higher than that for the actual dry substance, and that, indeed, the Brix is only a conventional figure, simply retained on account of its rapid and easy determination, while the estimation of the actual dry substance is a rather slow and tedious process. In this publication I have mentioned the value for the degrees Brix only because the manufacturers are used to it and would miss it if it was not there, but in the further discussion of the results I make exclusive use of the figures for actual dry substance and true quotient of purity.

I showed in a previous paper,* which did not appear in English, that the difference between the degrees Brix and the dry substance was exclusively to be ascribed to the influence of the salts and not to the glucose or the caramel. In fact, the salts occurring in cane sugar molasses show a proportion between specific gravity and dry substance, which is quite different from that of saccharose, for which body the tables are calculated.

The following table for the degrees Brix of some solutions, all containing 10% of solid matter, will make this clear at once:—

DEGREES BRIX AT 17·5° C. OF SOME 10% SOLUTIONS.

Saccharose..	10·0 after Brix.
Glucose	10·0 after Graham, Hofmann & Redwood.
Fructose	10·0 after Hönig & Jesser.
Sodium chloride	17·8 after Gerlach.
Potassium chloride ..	16·0 after Gerlach.
Calcium chloride	20·8 after Gerlach.
Potassium sulphate ..	19·9 after Gerlach.
Potassium acetate ..	12·3 after Gerlach.
Sodium acetate	13·2 after Gerlach.
Calcium acetate.. ..	12·2 after Gerlach.
Potassium tartrate ..	15·9 after Gerlach.

The content of salts only partially finds its expression in the ash quotient, since the salts of *inorganic* acids are found in the figure for the ash for their full amount, while those of *organic* acids leave carbonates after incineration, the weight of which is only a part of that of the original salt. In case of much organic acid in the salts, the amount of ash is smaller than if the majority of the salts had been of inorganic acids. For this reason as well as on account of every salt having its own relation between specific gravity and dry substance in solution, no fixed factor could be found, with which the ash content must be multiplied in order to find the figure for the difference between degrees Brix and dry substance in the molasses. The 1902 researches gave as an average factor 0·6-0·7, which implies that for an indirect determination of solid matter in an exhausted molasses, the figure for the ash has to be multiplied by 0·6 to 0·7 and the product subtracted from the degrees Brix at 17·5° C. in order to get the figure for the actual dry substance. The last time, I found an average factor of 0·63, with a maximum of 0·89 and a minimum of 0·47, and only about 20% of the molasses, showing larger deviations from the average than 0·10.

POLARIZATION.

I have already observed that the direct polarization, as it is made in these investigations, does not yield the real direct polarization of the whole complement of sugars, because the clarification by means of sub-acetate of lead precipitates part of the fructose and therefore occasions the polariscopical reading to be somewhat higher than it really ought to be. But as has already been remarked, the lack of a suitable clarifying reagent, not possessing this or a similar inconvenience compels us to accept the position as it is and to allow for the slight error. I computed from the difference between direct polarization and the polarization after Clerget how much the other optically active substances in the molasses participated in the rotation. The clarification with the lead reagent eliminated all the active acids, only leaving the sugars as active bodies, the sucrose was already accounted for by the polarization after Clerget, so that only the reducing sugars participated in the difference between the total polarization and that of the sucrose.

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* Archief voor de Java Suikerindustrie, 1902-3.

In the tables this rotatory power expressed in degrees Ventzke is calculated on 100 parts of reducing sugar (also, though scientifically incorrect, called glucose). From these figures we see that the complex of reducing sugars in the molasses of factories, clarifying the juice after the carbonatation process have a rotation of about 0·0; it is only a trifle positive or negative, but to such a restricted degree that we are justified in the conclusion that the carbonatation process changes the rotation of the reducing sugar in cane juice in such a manner that the individual rotations of the constituents neutralize each other, giving way to an optically inactive mixture. This phenomenon is in full accordance with the researches of Lobry de Bruyn and Alberda van Ekesteyn,* who stated that every mixture of glucose and fructose in alkaline solutions, as far as it is not destroyed by the alkali, is transformed into a mixture of glucose, fructose and mannose of such a composition, that the rotations of the different constituents neutralize each other, so as to make the solution optically inactive.

The saturation of the excess of lime with a current of carbonic acid in the carbonatation tanks of course stops the action of the lime on the reducing sugars. If a subsequent inversion makes the mixture of reducing sugars lævo-rotatory again, then this rotation persists and will be found again in the molasses. The fact that there the rotation of the reducing sugar is equal to 0·0 proves that the manufacture of white sugar, which is the chief product of carbonating factories, does not lead to an appreciable inversion of saccharose.

The rotatory power of the reducing sugar in the juice of factories, where the juice is clarified by defecation, is not so strongly influenced by the lime as in the carbonatation process; in the first place because the amount of lime added is much less, and, moreover, it becomes at once neutralized by the acids of the juice or by those formed by the decomposition of the glucose. Here the original composition of the reducing sugar in the juice is the principal factor, which influences the rotatory power of these sugars in the molasses, unless during manufacture a sourness and inversion of the juice had considerably increased the left-handed rotation. We do not know the original rotation of the reducing sugar of the juice, and therefore cannot tell exactly either from the percentage or from the rotation of these constituents whether a part of the glucose had been formed from saccharose in the course of manufacture or not. But we notice that a strong left-handed rotation occurs as well in molasses from factories, where the molasses is already exhausted in one operation a few hours after it has entered in the shape of juice into the clarifiers, as in those where it was only considered as waste molasses after repeated boiling and crystallizing for weeks in the crystallization tanks.

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* Recueil des travaux Chimiques de Pays-Bas, Tome 14, 156, 230.

So we find, for instance, the rotation of the reducing sugar in molasses No. 21 is almost as much to the left as the highest left-handed rotation of one of the molasses from the other list, where the opportunity for inversion has been so much the greater.

Taken as a whole, the rotation of the reducing sugars from Table No. 1, *i.e.*, the molasses obtained by direct work, was —22·5, and that of Table No. II., of the molasses obtained from after-products, only —19·9, showing clearly that no inversion was produced by the slow work of boiling and cooling of seconds.

QUOTIENT OF PURITY.

In the tables I entered two series of figures for the quotient of purity, viz., the conventional one for the apparent quotient, calculated by dividing 100 × the figure for the direct polarization by the degrees Brix, and that for the true quotient, obtained by dividing 100 × the actual sucrose figures (polarization after Clerget) by the dry substance. It is probably superfluous to point out again that the former figure, though the only one used in practical working, cannot be made use of here, because all and every influence contributes towards making it appear too low. I have mentioned it here only because the manufacturers are used to it, and next in order to show distinctly how much it deviates from the real figure, which presents a strikingly high value for these who are acquainted with the apparent figure only.

In the molasses from carbonatation, where the left-handed rotation of the reducing sugars is almost nil, and where, therefore, one of the sources of error and difference is eliminated, the difference between the two quotients is not so great as in the molasses from defecation. If, therefore, we should judge the effect of the clarification by the degree of the lowering of the quotient of the molasses and then adopt the usual figure, *i.e.*, the apparent quotient, as the point of comparison, we run the risk of being unfair to the factories which clarify with the carbonatation process. Where the apparent quotients show rather large differences between those two rubrics, the true quotients do not differ perceptibly for the various sub-divisions of the molasses under consideration as appears from the sub-joined table:—

Carbonatation molasses from first sugars (List I.) ..	39·9
Defecation molasses from first sugars (List I.) ...	43·33
Carbonatation molasses from after-products (List II.)	40·20
Defecation molasses from after-products (List II.) ..	40·52

These figures of course do not allow of a completely fair comparison, as the original quotient of the cane juice has not been the same for every one of the sub-divisions and since not all the factories reported that figure when sending the molasses, the true comparison cannot be made, but anyhow the table shows that there is no well-marked difference in true quotient between the different groups of molasses.

In order to examine this point further, I calculated the difference in quotient between the molasses and the original cane juice, from which the molasses have come, so far as the figures for the quotient of that juice stood at my disposal. I must state beforehand that even this figure, too, is incorrect and this for two reasons. First, the purity of the cane juice is surely that of the juice from the same period as that from which the molasses result, but it is impossible to say that the molasses have actually originated from that identical juice.

In the second place, the purity of the juice is also the apparent one and likewise diminished by the influence of the salts and the glucose. It is true that this influence is not so perceptible as in the case of molasses and in the maximum case will not exceed a few points, but as the amount of ash and the rotation of the glucose were unknown, I could not calculate the actual quotient of the raw juice, and therefore was forced to compare in the tables the apparent quotient of the juice with both the apparent and the real quotients of the molasses. The real degree of desaccharification, which if no inversion at all had taken place would be represented by the difference between the real quotients both of juice and of molasses, now comes between the two values in the tables but is more on the side of the difference between the quotient of the juice and the real one of the molasses, or the last column of the tables.

When we calculate the average difference for the two chief divisions as far as the figures for the quotient of the juice allow us to do so, (the number of carbonatation factories now becoming too small, I did not continue the sub-division after the methods of clarification), we see that the average degree of desaccharification of the juice for factories, where the molasses are already exhausted in the pan, is 41·3, and for those, where also after-products are made, yet a little more or 44·5.

The discussion of the rotation of the reducing sugars led to the conclusion that no perceptible inversion could be detected, and the foregoing calculations and observations even emphasize this and show that the making of after-products instead of diminishing the yield of sugar by inversion rather improves the degree of desaccharification, properly speaking, by a greater fall in the quotient from juice to molasses. It is however possible that this advantage is more than compensated for or neutralized by the mechanical losses during the repeated transport of masse-cuite and sugar, and during the repeated centrifugalling, so that at any rate the financial results are more favourable for the system of first sugar and molasses in one operation; but here, where we only discuss the influence of the two ways of working on the constitution of the molasses, these considerations are beyond the scope of our paper.

The tables prove again, what I put forward in my former paper on waste molasses,* that when judging the effect of some way of working in the factory, the mere figure for the quotient of the exhausted molasses is not the sole criterion, unless we consider it in connection with the initial quotient of the original cane juice. The true quotient for the molasses of the undermentioned factories, for instance, is rather high, but they were originally from such pure juices that the total drop between the two quotients remains above the average. It will be apparent from previous discussion that the constitution of the non-saccharine matter which accompanies the sugars in the juices, often interferes with the desaccharification thus preventing the fixing of a limit, down to which every cane sugar molasses ought to be desaccharified till it may be deemed actually exhausted.

No.	Name of the factory.	Quotient cane juice.	Final quotient exhausted molasses.	Fall.
2	Kadhipaten	89·2 ..	40·62 ..	48·58
33	Djati Carang	89·12 ..	43·00 ..	46·12
39	Karang Soewoeng.. ..	90·5 ..	44·54 ..	45·96
40	Kemanglen..	90·33 ..	42·68 .	47·55

INCOMBUSTIBLE MATTER.

When incinerating the molasses for the determination of the ash, the same phenomenon was observed as mentioned in the previous paper on molasses,† namely, that the molasses from carbonatation factories frothed violently when heated in the platinum saucer. I then ascribed this to the lactic acid of those molasses, and nothing has occurred since to induce me to change my mind. Since the appearance of my last mentioned paper, lactic acid has also been found to be a constituent of beet sugar molasses.‡

For distinction's sake I kept the soluble and the insoluble parts of the ashes apart and would remark here, that all the lime and the magnesia were always in the insoluble portion; the soluble ash, which owing to the presence of alkali carbonates had in every instance an alkaline reaction, contained all of the alkali metals, of the sulphate, and of the chlorine.

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*I.S.J., 1901, 516. †I.S.J., 1901, 575. ‡Vereinszeitschrift, 1901, 720.

After evaporating the solution of the insoluble part in hydrochloric acid and drying the residuum in a hot air bath, this was again dissolved in water and acidulated with hydrochloric acid, while the silica remained undissolved and could be filtered off and determined. The resulting filtrate was supersaturated with ammonia, and the precipitate thrown down by this reagent, filtered off, washed, dried, ignited and weighed without further attempt to separate it in its elements. It is recorded in the tables as "iron and calcium phosphate." The quantity of this precipitate is small in the carbonatation molasses, and even in the sample which contains most of it is much inferior to the lowest percentage in the defecation molasses. This is in full accord with the fact already mentioned[*] that the phosphates in clarified cane juice do not occur in solution but in suspension, and in cases, as in carbonatation juices, where a thorough filtration of the total amount of juice is possible, they are more apt to be removed than in the majority of the cases, where nine-tenths of the juice is not filtered at all, but only clarified by subsiding. The same thing is also true for the silica; in the list we find almost total absence of this body in the ash of the carbonatation molasses, while the defecation molasses contain more silica, which has escaped the clarification at the outset of manufacture.

The silica and the phosphates met with in the molasses may therefore be considered as accidental impurities, because they occurred in suspension in the juice, and because it was merely a matter of chance whether they were dragged along with the molasses or were deposited as scale on the tubes or coils of the evaporation vessels. This is the principal reason why I did not take the trouble to analyze these precipitates; in fact they have the same constitution as the scales in the evaporating vessels, from which they only differ in so far that the latter have been deposited and the former not. For the same reason I did not add the lime contained in these phosphates to the rest of the lime which, occurring in the molasses in solution in the shape of lime salts, is a real component of the same.

Just as in my former researches,[†] I calculated the amount of lime on 100 parts of ash, and this time entered these figures in the tables. The average lime content of the ash was this year 15·57% for carbonatation molasses and 6·25% for defecation molasses. In 1892 those figures were respectively 26·8 and 10·8, and in 1900, 16·9 and 7·03, which means a constant decrease in the percentage of soluble lime salts in the molasses. This is not astonishing, when one remembers how much more attention is paid to the proper amount of milk of lime used for clarification, and how the formerly usual addition of milk of lime to the subsided scums and to the molasses has gradually been abolished. It is evident that not the whole amount of the lime, found back in the molasses, originates from the lime used for the clarification, as it is not impossible that at least part of that constituent had already been present in the raw cane juice, but the gradual decrease in the percentage of lime is a happy consequence of the repeated advice not to use more lime in clarification than is strictly necessary. Not because lime is so expensive, but at a high temperature an excess of lime attacks the glucose, forms lime salts with their products of decomposition, which have the troublesome properties of being dark coloured, sticky, and easily broken up into acids; this can, of course, be prevented by a judicious tempering of the juice with lime.

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[*] Archief voor de Java Suikerindustrie, 1905, 164.

[†] *I.S.J.*, 1901, 577.

Among the factories, the molasses of which excelled by their small amount of lime, we quote especially Winongan No. 21, Pradjekan No. 61, and Tangarang No. 69. I was anxious to know whether in those factories some or other material was used after clarification for precipitating the lime, and I therefore requested the managers of the three factories to let me know how the juice was clarified on their estates, and whether they made use of some special clarifying reagent. The answers were almost identical, the sole clarifying agent was lime, but great attention was paid to its tempering in order to ensure that sufficient lime was always added to the juice to make it settle rapidly, yet cautiously avoiding an excess.

It is quite possible to prevent decomposition of glucose and formation of lime salts of organic acids by a judicious tempering, and therefore the fact that some molasses contain more lime may not immediately lead to the conclusion that in those cases too much lime has been used and that the work has not been conducted with the necessary care, for it is very well possible that the lime had already been present in the juice, and so need not be greatly increased during clarification. This can only be decided by direct analysis of the ash of the raw juice; and this work is already being taken up by the Experiment Station's staff.

The figure for the magnesia does not call for any particular mention. It is insignificant, but is never missed ; it is not brought into the juice in the lime, as this is generally pure, so that it proves that magnesia salts are a common constituent of Java cane juices.

The potash content, on the contrary, is more prone to furnish matter for discussion. First we observe that in normal cases, such as here, where an average molasses resulting from a whole period is analyzed, the potash is almost the only one of the two alkali metals which is found in the cane juice. Only in very rare cases the soda amounted to 0·25% in the ash, but in the great majority of molasses this element was either totally absent or did not come above a few per cent. of the potash figure. The reason of this phenomenon is explained in a former paper* on the influence of salt on the constitution of the sugar cane, in which experiments showed that even in the presence of a large excess of soda salts, the cane assimilates preferably the potash if available, and if this be not so, will sooner wither and die than assimilate the soda salts. The potash content of the molasses varies very much, ranging from a little over 2% up to 6%, between which limits the whole of the potash figures fluctuate without showing any regularity.

The already mentioned investigations on the assimilation of inorganic substances from the soil by sugar cane growing in it, prove that a considerable influence was exercised on the dissolution and assimilation of the potash salts by different reagents, which makes the potash content of the juice a rather inconstant figure. A high potash content of the molasses does not mean that a quantity of juice has yielded very little molasses in which the potash from the juice is concentrated, but is generally a consequence of the original juice being already rich in potash. This supposition is supported by the agreement which we perceive in the potash figures of the molasses of the same estates, made in 1900, and now. Notwithstanding the lapse of five years, and the fact that the molasses need not come from canes grown in the same fields, the potash contents as published in 1901 agree with those of the present investigation. The table given below contains the potash contents of all the molasses mentioned in the two papers, and of some of the analyses published in 1893.

Name of the Factory.	1900.†	1905.	1892.‡
Kadhipaten	3·50	3·38, 3·27	3·05
Djatiwangi	3·76	3·86	—
Wonopringgo	3·35	2·32	2·74
Sindang laoet	4·67	4·07	—
Karang Soewoeng	4·87	5·35	5·06
Ketanggoengan West	4·30	4·51	—
Kemanglen	2·25	3·10	—
Doekoewringin	3·48	3·44	3·32
Kemantran	4·04	4·17, 4·25	—
Djatibarang	2·46	3·96	2·67
Poerwokerto	4·92	3·62	—
Pagongan	4·06	4·06	—
Sragi	3·61	3·32	—
Tirto	2·26	2·62	2·97
Remboen	2·68	3·48	—
Tjepiring	3·98	4·67	—
Pakkies	1·93	3·50	—
Djati	3·70	3·90	—

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* *I.S.J.*, Dec., 1905.

† *I.S.J.*, 1901, page 521.

‡ *Sugar Cane*, 1893, page 598.

Name of the Factory.	1900.*	1905,	1892.†
Goedo	2·80	4·07	—
Maron	5·65	5·48	—
Sewoe Galoor	3·08	2·48	—
Bodjong	4·10	3·54	—
Adiwerna	2·49	3·76	2·90
Balapoelang	3·86	3·17	3·14
Bandjardawa	3·69	3·24	2·44
Tjomal	4·16	3·89	—
Wonosari	3·09	2·98	—
Majong	3·60	3·73	—
Trangkil	3·28	4·32	—
Kentjong	3·70	3·93	—
Bogohkidoel	2·69	3·96	—
Tjoekir	3·08	3·76	—
Brangkal	4·22	3·31	—
Perning	3·67	3·30	—
Pandaän	3·81	3·34	—
Seboroh	4·44	4·44	—
Sroenie	4·83	4·03	—
Minggiran	4·19	4·01	—

In a few instances the figures for the potash content are entirely identical, and in many other cases a molasses showing a high potash amount in one list is also high in the other one. The potash content of the cane is therefore very dependent on the nature of the soil and other agricultural conditions, which, since potash is the chief element among the inorganic constituents of the cane juice can lead to far-reaching consequences in the study of the coincidence of a high ash-content and a low quotient of cane juice.

The last column in the tables is that for the carbonic acid in the ash, which is the expression of the quantity of organic acids combined with bases which were found in the molasses and now after ignition are transformed into carbonates. The molasses of factories working with carbonatation, by which process more of the glucose is transformed into acids, show a greater content of carbonic acid than the molasses from defecation factories, but this figure does not afford any more discussion.

(To be continued.)

The outlook for the coming Cuban crop is not as good as was expected. Some factories may only produce 60% of the total of last campaign. Drought has been very general during the past summer, and it is feared that the new crop will not attain to the million tons of former years.

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* *I.S.J.*, 1901, page 521. † *Sugar Cane*, 1893, page 598.

CHEMICAL CONTROL OF CANE SUGAR FACTORIES.

By William D. Horne, Ph.D.

(Continued from page 65.)

Analyses.

Cane.—Determine fibre only. Weigh about 1 kilogram of the sample pieces, crush in small mill to extract about 720 gms. of juice. Weigh the bagasse after chopping into small pieces and mixing thoroughly; weigh out 4 or 5 gms. and after comminuting finely extract by water under pressure, first cold then hot. This can be done very conveniently in the following manner: A burette tube is arranged to pass vertically through rubber stoppers closing the ends of a 15-inch glass cylinder about 2 inches in diameter, easily made by cutting the foot off of an ordinary cylinder such as is used in taking the density of solution. A quarter-inch brass tube also issues from the bottom stopper, passes outward and upward at an angle of 45 degrees for two or three inches, then straight up to the level of the top of the large cylinder, then across and down through the upper stopper two or three inches into the large cylinder. The large cylinder is filled with water to a level an inch above the bottom of this tube. A Bunsen burner or other flame is placed under this outer tube at the bottom of its upright portion and thus gradually heats the water in the outer tube. At the highest point of the heating tube is a ⊥ connection for withdrawing the air before operating. A thermometer passes through the upper stopper and its bulb is placed by the middle of the charge of bagasse to be extracted, which rests on a cotton or other suitable plug in the bottom of the burette. Another plug is placed above the charge, and water is admitted from a reservoir above to the burette. It passes out below by means of a rubber tube which is brought up in goose-neck fashion to a point above the level of the top of the charge and thence passes down again to the bottom level where it is closed by a compression cock.

To operate the apparatus allow water to flow slowly down the burette tube until the charge is covered and water overflows from the rubber tube. Regulate the flow by means of the compression cock, so that about 100 cc. will flow off in ten minutes. After working ten minutes place a small flame under the heating tube, so that the temperature indicated by the thermometer will rise to 65 degrees C. in ten minutes more, and keep it so for twenty minutes. Then increase the heat so that the water in the heating tube will boil in ten minutes more and keep the extractor running until no more soluble matter is extracted. Turn the apparatus upside down; wash out the charge into a filter and dry the fibre to a constant weight in a water-jacketed air bath.

Juice.—Strain through a cone of fine brass or copper sieving and allow air bubbles to separate. Take the density with a Brix spindle including a thermometer made in the spindle and provided with a Multiple Temperature Correction Scale.* For the polarization add to an unmeasured quantity of the juice sufficient dry lead sub-acetate to clarify, avoiding an excess, mix, filter and polarize. The per cent. of sucrose can be obtained by reference to Schmitz's tables and dividing the result there found by 1·1. The purity may be found (1) by Horne's tables, given in Spencer's new edition of his Handbook for Cane Sugar Manufacturers, p. 314; or (2) by multiplying the polarization by the factor corresponding to the Brix, which is obtained by dividing 26·048 by the product of the Brix by the corresponding specific gravity; or (3) by dividing the percentage of sugar found by the Brix and multiplying by 100.

Glucose is determined in a portion of the original sample. Weigh 20 gms., add lead sub-acetate to clarify, make up 100 cc. and filter. To 50 cc. of the filtrate (=10 gms.) add 10 cc. double normal potassium oxalate solution, make up to 100 cc. and filter. Use this solution for volumetric titration of 10 cc. of mixed Fehling Solution and 40 cc. of water, using potassium ferrocyanide and acetic acid for the end reaction.

Bagasse.—Put 50 gms. bagasse into a tared flask having a neck $1\frac{1}{4}$ inches in diameter with 450 gms. water (containing 5 cc. of 5 per cent. sodium carbonate solution) and boil gently for one hour, with reflux condensor. A glass tube about 30 inches long and $\frac{1}{4}$ inch in diameter extending vertically through the stopper of the flask answers the purpose. Make up to the original weight, shake frequently, cool and filter, clarify the filtrate with dry sub-acetate of lead, filter and polarize.

$$\frac{\text{Pol.} \times 260{\cdot}48 \times (500 - \text{gms. fibre in 50 gms. bagasse})}{100 \times \text{Sp. Gr.} \times 500} = \% \text{ Sucrose in}$$

bagasse. Or

$$\frac{\text{Pol.} \times {\cdot}26048 \times (1000 - 2 \text{ fibre})}{100 \times \text{Sp. Gr.}} = \% \text{ Sucrose in bagasse.}$$

To obtain the Brix, extract a sample without adding sodium carbonate, cool, filter and obtain Brix with spindle or preferably with a Westphal balance. To obtain the purity of the residual juice in bagasse divide the per cent. of sugar in the extract by its Brix and multiply by 100. The per cent. sugar in the extract equals

$$\frac{\text{Pol.} \times 26{\cdot}048}{100 \times \text{Sp. Gr.}}, \text{ using the dry lead to clarify.}$$

Fibre can be determined on 3 grams in the same manner as in cane.

Syrups.—The Brix is taken directly. Then weigh off 26·048 gms., make up 100 cc., clarify with dry lead sub-acetate, filter and polarize. The purity is calculated by dividing 100 times the polarization by the

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* Made by A. A. Weiss & Co., 684, Park Avenue, Brooklyn, N.Y.

Brix. Or the syrup can be diluted without weighing to about 15 or 16 Brix and tested by Casamajor's method.

Magmas.—For moisture, weigh 100 gms. and add 400 gms. of water. Take the Brix and multiply by five. 100 — solids thus obtained = water. The results, while not strictly correct, are still perfectly comparable, and serve to control the work.

Molasses.—Weigh 300 gms. molasses, add 300 gms. water. Take Brix and multiply by two. Make up 26·048 gms. to 100 cc. using solution of sub-acetate of lead and alumnia cream to clarify. Withdraw 50 cc. of this solution, add to it acetic acid to produce a neutral or slightly acid reaction, make up to 55 cc., polarize this and multiply by 2·2. For glucose take 19·2 cc. of the original lead filtrate, containing $2\frac{1}{2}$ gms. molasses, dilute, with addition of potassium oxalate, to 100 cc. and filter. Take 40 cc. of this (= 1 gm. molasses) dilute to 100 cc. and titrate as above. For moisture weigh off 1 gm. of the original molasses into a 3 in. flat bottomed dish about $\frac{5}{8}$ in. high containing a glass rod, dissolve in water and add about 30 gms. ignited quartz sand weighed exactly. Evaporate with frequent stirring on open water bath until it appears to be dry, which should be in 30 minutes. Then dry to constant weight in a water-jacketed air bath, which should not require over two hours.

For ash, weigh 2 gms. into a weighed platinum dish, add 16 drops of strong sulphuric acid, ignite gently to a fluffy ash, cool, add two to four drops sulphuric acid, ignite and weigh. Multiply by $\frac{9}{10}$.

The remainder, after subtracting the sum of the water, sucrose, glucose and ash from 100 can be reported as organic non-sugar.

Sugars.—Determine moisture in 2 gm. portion, drying first for half an hour on open bath and then until constant in a water-jacketed air bath. Sucrose is to be determined by the present official method of dissolving 26·048 gms. in water clarifying with solution of basic lead acetate and alumnia cream, making up to 100 cc. filtering and polarizing. Glucose is to be determined in the clarified portion used for polarizing. 19·2 cc. of the filtrate, representing 5 gms. of the sugar, or some multiple of this quantity is used, the excess of lead, if any be present, is precipitated by potassium oxalate, the whole made up to 100 cc. filtered, and the glucose determined volumetrically with Fehling solution. Determine ash as above, in molasses.

Press Cake.—Thoroughly mash and mix discs of cake, weigh off 25 gms., mix into a thin batter with water, add solution of lead sub-acetate to clarify, make up to 200 cc., filter, polarize and multiply by two. For moisture weigh 5 gms. in flat bottomed dish, dry on an open water bath and finish in a water-jacketed air bath.

Condensation Water.—Weigh 2,000 gms. in a shallow, flat bottomed evaporator, like a tin milk pan, evaporate down to 100 gms., clarify with dry lead subacetate and polarize.

$$\% \text{ Sucrose} = \frac{\text{Pol.} \times 26{\cdot}048}{100 \times \text{Sp. Gr.} \times 20}$$

Sewer water.—Collect hourly and preserve in a bottle containing formaldehyde. Twice a day polarize a sample, clarifying with dry lead subacetate.

$$\% \text{ Sucrose} = \frac{\text{Pol.} \times 26{\cdot}048}{100 \times \text{Sp. Gr.}}$$

CALCULATIONS.

Cubic feet of water × pounds per cubic foot at average temperature = pounds of water used.

Cubic feet of juice × pounds per cubic foot at average Brix corrected for temperature = pounds of juice, undiluted or diluted.

100 wt. of juice ÷ wt. of cane = juice per cent. cane.

$$\frac{100\,(\text{Brix undiluted juice} - \text{Brix diluted juice})}{\text{Brix undiluted juice}} = \text{dilution water}$$

per cent. dilute juice.

Dilute juice per cent. cane × per cent. dilution water in dilute juice = dilution water per cent. cane.

Dilute juice per cent. cane − dilution water per cent. cane = undiluted juice per cent. cane, called "Extraction." Or,

$$\frac{\text{Bx. dil. j.}}{\text{Bx. undil. j.}} \times \frac{\text{wt. dil. j.} \times 100}{\text{wt. cane}} = \text{undil. j. per cent. cane} = \text{"Extraction"}$$

When maceration is employed find the Brix of the mixed undiluted juice from the Brix of the juice from the crusher and first mill combined, by multiplying by the factor

$$\frac{\text{Brix of mixed juice}}{\text{Brix of first mill juice}}$$

obtained when not macerating.

Dilute j. per cent. cane × Sucrose in dil. j. = Sucrose in juice, per cent. cane.

100 − Extraction = Bagasse, per cent. cane.

Sucrose in juice per cent. cane, plus sucrose in Bagasse per cent. cane = per cent. sucrose in cane.

100 wt. water used ÷ wt. cane = maceration per cent. cane.

$$\text{Dilution per cent. cane} = \frac{\left\{1 - \frac{\text{Bx. dil. juice}}{\text{Bx. undil. juice}}\right\} \times \text{wt. dilute juice} \times 100}{\text{weight cane.}}$$

Per cent. of water of maceration which goes into dilute juice.

$$= \frac{\left\{1 - \frac{\text{Brix dil. juice}}{\text{Brix undil. juice}}\right\} \times \text{weight of dilute juice} \times 100}{\text{weight of water used.}}$$

100 − this per cent. = the per cent. of maceration water remaining in the Bagasse.

The effect of macerating may be studied by the following formulas when it is impossible to weigh or measure the maceration water put on the cane. Let "Normal juice" be understood as the juice as it occurs in the cane. "Undiluted juice" or "Mixed juice" is that coming from the mills without admixture of water. "Dilute juice" is that containing water. "Residual juice," that remaining in the bagasse. "Maceration water" is the entire amount put on; "Dilution water" is that passing off with the juice; "Absorbed water" is that remaining in the bagasse. "Bagasse" is the fibrous mass as it passes from the last mill containing such amounts of proximate constituents as the treatment may have left in it.

Given the weight of cane ground, a;
Weight of dilute juice, H;
Brix of undiluted juice, b; diluted juice, c;
Per cent. fibre in bagasse without maceration, d;
Per cent. fibre in bagasse with maceration, e;
Per cent. water in bagasse without maceration, f;
Per cent. water in bagasse with maceration, g;

$$\text{Dilution per cent. cane} = \frac{\left(1-\frac{c}{b}\right) H \times 100}{a}$$

This gives the pounds of maceration water going into the juice.

$$\left.\begin{array}{l}\text{Absorbed water in macerated}\\ \text{bagasse, per cent. cane}\end{array}\right\} = g - f \times \frac{e}{d} \times \frac{\text{per cent. Bagasse on cane}}{100}$$

This gives the pounds of maceration water remaining in the bagasse.

The sum of these two = water of maceration, per cent. cane.

The per cent. of bagasse on cane may be found by subtracting from 100 the per cent. of undiluted juice, whether this be obtained directly or through calculation from the diluted juice.

Efficiency of Saturation.—Find the tons of fibre, juice and water entering and leaving a set of rolls. (Tons water by meter.) Get the juice remaining in bagasse per cent. juice entering $= a$.

Get water remaining in bagasse per cent. water entering $= b$. $100\, b \div a =$ efficiency of saturation; that is the degree to which water has become thoroughly mixed with juice in the cane.

Yield of sucrose from magma or other sources, on dry basis.

$$\text{Yield} = \frac{100 \text{ purity masse-cuite} - \text{purity molasses.}}{\text{Purity sugar} - \text{purity molasses}}.$$

If the yield of moist sugar from moist masse-cuite, meladura or other source be required, multiply this value by $\frac{\text{Brix masse-cuite.}}{\text{Brix of sugar.}}$

Yield of sugars per cent. sucrose in juice =

$$\frac{100 \text{ wt. Sugars.}}{\text{wt. j.} \times \text{per cent. sucrose in juice.}}$$

Sucrose recovered per cent. sucrose in cane =

$$\frac{100\ (\text{wt. Sugar} \times \text{Pol.} + \text{wt. mol.} \times \text{Pol.})}{\text{wt. cane} \times \text{Pol.}}$$

Also applicable to sucrose in all other products, as bagasse, press cake, molasses, &c.

SUGAR BEET GROWING EXPERIMENTS IN GREAT BRITAIN AND IRELAND, 1905. (Eleventh Report.)

By Sigmund Stein

(Sugar Expert, Liverpool).

I have the honour to present to my friends my eleventh report on my experimental work in sugar beet growing. I do not need to dwell on the many points which I clearly discussed in my ten previous reports, but will only say that the results obtained in these experiments show constantly better results every year, which is only to be expected considering that my farmer friends now know well how to grow sugar beet after so many years' experiments and so many trials.

As it will be seen from the tables annexed, there has been a variety of soils, and of manures; and the time of vegetation varied from 133 days to 190 days.

I have, as in previous years, tried different seeds just to test the climate and the soil, and the results will be found in the tables annexed.

The yield of roots per acre in the experimental year (1905) amounted to 16·00 tons per acre. As in previous years I have compared my results with those of Mr. Licht, Madgeburg, and they show the following comparative results:—

	British roots. 1905.	German roots. 1905.
Average weight of roots with leaves, in grammes	1611	927
Average weight of roots without leaves, in grammes	996	495
Degree Brix (dry matter)	20·13	19·30
Specific gravity	1·084	1·080
Quantity of Sugar in 100 parts of juice	17·50	17·00
Quantity of Non-Sugar in 100 parts of juice	2·63	2·30
Quotient of purity	87·30	88·08
Quantity of Sugar in 100 parts of roots	15·93	15·10

From an inspection of these figures one will see that we can grow in our country very much larger roots than on the Continent of Europe, and one will notice that British grown roots are richer in saccharine matter than Continental grown ones. The average weight of German grown roots without leaves is given as 495 grammes, but the average weight of the British grown roots was 996 grammes, that is to say, the British grown roots had double the size and double the weight of German grown roots. German roots show 15·10% of sugar in the roots, British roots, however, 15·93%. These figures show that we can grow more sugar per acre in the United Kingdom than on the Continent. I have proved this in over 2,500 experiments which I have made in previous years. I don't think there will be anybody who will dispute the fact that our roots are richer in saccharine matter than Continental grown roots.

My analyses have been checked by several of my friends who worked with me and they not only verified my figures but their own analyses even showed a much higher percentage. I may just mention that Prof. Clarke, of Chelmsford, showed me his analyses of the beetroots grown in Essex and these show a much higher figure than any I have published in my tables.

Regarding the quantity of juice and pulp, the average in 1905 was as follows :—

	Per cent.
Juice	93·82
Pulp	6·18
Total	100

The average yield of roots per acre on the Continent amounts to 12 to 13 tons. How does it stand in the United Kingdom? Here is the tonnage of British grown roots per acre as shown in my experiments.

Year.	Tons.	Year.	Tons.
1897	16·07	1902	15·90
1898	16·03	1903	14·50
1899	16·09	1904	16·86
1900	19·01	1905	16·00
1901	19·04		

Twelve experiments have been carried out in England and 26 experiments in Scotland, making a total of 38 experiments for which I can give full particulars and precise data as supplied to me. Unfortunately, the Irish grown roots came too late for this report. As in previous years, trouble arose with the experimenters who did not properly label their roots which they sent to my laboratory for record and analysis, and I have been compelled to omit such parcels from my report.

Through my frequent absence from England this year I could not carry out my experiments of sugar beet growing so extensively as in former years. I could not inspect the different experimental plots so closely and devote so much attention to the cultivation as I would liked to have done. But I corresponded with my experimenters and visited them occasionally as often as it was possible.

All the analyses have been made according to the newest methods and with the newest apparatus which are at my disposal.

AVERAGES AND RESULTS OF THE EXPERIMENTAL WORK IN SUGAR BEET GROWING.

Carried out by Sigmund Stein, Liverpool.

Table I.—Average Yield per Acre.

Year.	Tons per acre.	Year.	Tons per acre.
1897	16·07	1902	15·90
1898	16·03	1903	14·50
1899	16·09	1904	16·86
1900	19·01	1905	16·00
1901	19·04		

Table II.—Analysis of Roots.

Year.	Country.	Weight of roots with leaves, in grammes.	Weight of roots without leaves, in grammes.	Degrees Brix (dry matter).	Specific Gravity.	Quantity of Sugar in 100 parts of the juice.	Quantity of non-Sugar in 100 parts of the juice.	Quotient of Purity.
1897	British ..	1229	804	18·44	1·076	15·80	2·64	85·64
	German ..	1148	561	17·81	1·074	15·07	2·74	84·05
1898	British ..	1371	843	19·05	1·079	16·54	2·51	86·82
	German ..	974	539	19·02	1·079	16·32	2·70	85·80
1899	British ..	1644	902	19·00	1·079	16·30	2·70	85·78
	German ..	957	611	18·30	1·076	15·45	2·85	84·42
1900	British ..	1525	790	19·52	1·081	17·07	2·45	87·45
	German ..	1064	557	20·00	1·083	17·38	2·62	86·90
1901	British ..	1441	851	19·38	1·180	17·02	2·36	87·82
	German ..	1112	621	17·66	1·073	14·76	2·90	83·53
1902	British .	1326	878	19·29	1·080	16·80	2·49	85·11
	German ..	1042	492	17·43	1·072	14·79	2·64	82·74
1903	British ..	1516	933	19·93	1·083	17·28	2·65	86·98
	German ..	1100	560	19·70	1·082	16·87	2·83	85·63
1904	British ..	1491	892	20·25	1·084	17·65	2·60	87·04
	German ..	988	616	20·90	1·087	18·32	2·58	87·66
1905	British ..	1611	996	20·13	1·084	17·50	2·63	87·30
	German ..	927	495	19·30	1·080	17·00	2·30	88·08

ANALYSIS OF SUGAR BEETROOT

ENGLAND.

Reference No.	The Trials were made by	Farming at	What kind of Soil.	What Manure was used, and How much per Acre.	Yield of Roots per Acre.	Length of time of Vegetation.
1	Hon. Ernest George Pretyman, M.P.	Steel's Farm, Orwell, Suffolk	Sandy loam	12 loads farm yard manure	14	171
2	Rev. Edward Muckleston, M.A.	Haseley Farm, Warwickshire	Light soil, sandy subsoil	farmyard manure	27	193
3	Corporation of Northampton	Irigation Farm, Ecton, Northampton	Black loam	Liquid sewage	26	157
4	Corporation of Burton-on-Trent	Sewage Farm, Burton	Gravel	None	21	136
5	John Chivers, Esq., J.P.	Histon Farm, Cambridge	Loam, sandy subsoil	None	18	184
6	,, ,,	,, ,,	,, ,,	None	17	184
7	John Woolston, Esq., J.P.	North Fields Farm, Stamford, Lincolnshire	Medium, clay subsoil	12 loads farmyard manure and nitrate of soda	20	174
8	Messrs. W. & W. Bracey	Manor Farm, Martham, Norfolk	Mixed soil, clay subsoil	18 loads farmyard manure	21	179
9	Robert C. Alexander, Esq.	Easthorpe, Green, Essex	Heavy loam, marl subsoil	14 tons farmyard manure, 2 cwt. sulphate of ammonia, 4 cwt. superphosphate	13	166
10	L. W. F. Behrens, Esq.	Trenall's Farm, Marazion, Cornwall	Light soil, rocky subsoil	3 cwt. superphosphate, 2 cwt. sulphate of potash, 1 cwt. sulphate of ammonia	20	163
11	,, ,,	Villemouth Farm, Cornwall	,, ,,	,, ,, and farmyard manure	20	163
12	,, ,,	Rowe Farm, Cornwall	,, ,,	,, ,, and sea weed	20	163
	Average of the 12 Experiments in England				19½	169

Reference No.	Previous Crop.	Compared with Licht, Magdeburg.				Klein Wanzleben.					Aderstedt.					Vilmorin (blanche).				
		Average weight in grammes.	Sugar in 100 parts of Juice.	Non-sugar in 100 parts of Juice.	Purity.	Average weight in grammes.	Sugar in 100 parts of Juice.	Non-sugar in 100 parts of Juice.	Purity.	Sugar in 100 parts of Roots.	Average weight in grammes.	Sugar in 100 parts of Juice.	Non-sugar in 100 parts of Juice.	Purity.	Sugar in 100 parts of Roots.	Average weight in grammes.	Sugar in 100 parts of Juice.	Non-sugar in 100 parts of Juice.	Purity.	Sugar in 100 parts of Roots.
1	Wheat	495	17·00	2·30	88·08	1246	17·90	2·40	88·17	16·00	..	..	..	..	..	..	..	..	..	..
2	Potatoes	495	17·00	2·30	88·08	..	..	..	..	..	1410	19·30	2·40	88·94	17·00	..	..	..	..	..
3	Celery	495	17·00	2·30	88·08	..	..	..	..	..	..	..	..	..	..	1479	17·80	2·60	87·25	16·20
4	Turnips	495	17·00	2·30	88·08	1775	17·40	2·20	88·77	15·70	..	..	..	..	..	..	..	..	..	..
5	Wheat	495	17·00	2·30	88·08	1275	18·00	2·60	87·38	16·10	..	..	..	..	..	..	..	..	..	..
6	„	495	17·00	2·30	88·08	..	..	..	..	..	..	..	..	..	..	1124	16·70	2·70	86·08	15·40
7	„	495	17·00	2·30	88·08	..	..	..	..	..	1237	18·10	3·00	85·78	16·40	..	..	..	..	..
8	„	495	17·00	2·30	88·08	1138	18·70	3·20	85·38	17·00	..	..	..	..	..	..	..	..	..	..
9	Rye	495	17·00	2·30	88·08	..	..	..	..	..	1124	18·20	2·40	88·35	16·30	..	..	..	..	..
		Compared with Licht, Magdeburg.				Dippe.														
10	Fallow	495	17·00	2·30	88·08	1480	17·80	3·10	85·17	16·00	..	..	..	..	..	..	..	..	..	..
11	„	495	17·00	2·30	88·08	1510	17·70	2·60	87·19	15·40	..	..	..	..	..	..	..	..	..	..
12	„	495	17·00	2·30	88·08	1164	17·00	2·90	85·43	15·10	..	..	..	..	..	..	..	..	..	..
Average of the 12 Experiments in England......		..	..	..	..	1330	17·88	2·68	86·99	16·05	..	..	..	..	..	..	..	..	..	..

SCOTLAND.

Reference No.	The Trials were made by	Farming at	What kind of Soil.	What Manure was used, and How much per Acre.	Yield of Roots per Acre.	Length of time of Vegetation.
13	The Right Hon. Earl of Errol, K.T.	Home Farm, Stains Castle, Aberdeenshire	Sandy, sandy subsoil	3 cwt. superphosphate, 1 cwt. sulphate of ammonia, 1 cwt. high grade sulphate of potash	10	171
14	,, ,,	,, ,,	,, ,,	,, ,, ,,	8	171
15	,, ,,	,, ,,	,, ,,	,, ,, ,,	11	171
16	West of Scotland Agricultural College	Esp. Station, Home Farm, Kilmarnock, Ayrshire	Loamy soil on tilly subsoil.	10 tons of farmyard manure, 4 cwt, superphosphate, 2 cwt of kainite, 2 cwt. nitrate of soda	11	179
17	,, ,,	,, ,,	,, ,,	,, ,, ,,	14	179
18	,, ,,	,, ,,	,, ,,	,, ,, ,,	13	179
19	James Campbell, Esq.	Home Farm, Cullen, Banff.	Good loam, loamy subsoil.	20 loads dung, 3 cwt. superphosphate, 1 cwt. sulphate of ammonia, 1 cwt. sulphate of potash	12	199
20	,, ,,	,, ,,	,, ,,	,, ,, ,,	12	199
21	,, ,,	,, ,,	,, ,,	,, ,, ,,	13	199
22	James Craigmile, Esq.	Easter Echt, Aberdeenshire	Light, clay subsoil	4 cwt. slag, 4 cwt. superphosphate, 2 cwt. nitrate of potash	17	143
23	Miss Margaret Smith	Mill of Wardes Insch, Aberdeenshire	Loamy	4 cwt. turnip manure, 12 tons of farmyard manure	25	142
24	James Milne, Esq.	Cairnhill, Muchals, Kincardineshire	Clay loam, clay subsoil	20 tons farmyard manure, 3 cwt. superphosphate, 4 cwt. sulphate of ammonia	15	148
25	J. G. Hadden, Esq.	Stonehaven, Kincardineshire	Black	4 loads farmyard manure	17	142

Reference No.	Previous Crop.	Compared with Licht, Magdeburg.				Braune.					Aderstedt.					Vilmorin (blanche).				
		Average weight in grammes.	Sugar in 100 parts of Juice.	Non-sugar in 100 parts of Juice.	Purity.	Average weight in grammes.	Sugar in 100 parts of Juice.	Non-sugar in 100 parts of Juice.	Purity.	Sugar in 100 parts of Roots.	Average weight in grammes.	Sugar in 100 parts of Juice.	Non-sugar in 100 parts of Juice.	Purity.	Sugar in 100 parts of Roots.	Average weight in grammes.	Sugar in 100 parts of Juice.	Non-sugar in 100 parts of Juice.	Purity,	Sugar in 100 parts of Roots.
13	Oats…………………	495	17·00	2·30	88·08	811	17·70	2·60	87·19	16·20	..	..	..	..	..	..	..	..	..	..
14	„ …………………	495	17·00	2·30	88·08	..	..	..	..	..	792	16·00	2·30	87·43	15·10	..	..	..	..	..
15	„ …………………	495	17·00	2·30	88·08	..	..	..	..	..	..	..	..	..	..	816	18·10	2·80	86·60	16·40
16	Barley………………	495	17·00	2·30	88·08	820	17·30	2·40	87·82	15·30	..	..	..	..	..	..	..	..	..	..
17	„ …………………	495	17·00	2·30	88·08	..	..	..	..	..	911	18·50	2·40	88 51	15·90	..	..	..	..	..
18	„ …………………	495	17·00	2·30	88·08	..	..	..	..	..	..	..	..	..	..	786	17·40	2·70	86·56	15·60
19	Oats…………………	495	17·00	2·30	88·08	..	..	..	..	..	890	16·80	2·30	87·95	15·20	..	..	..	..	..
20	„ …………………	495	17·00	2·30	88·08	..	..	..	..	..	..	..	..	..	..	840	17·50	2·90	85·78	15·60
21	„ …………………	495	17·00	2·30	88·08	785	18·10	2·70	87·02	16·10	..	..	..	..	..	..	..	..	..	..
22	„ …………………	495	17·00	2·30	88·08	..	..	..	..	..	781	18·50	2·90	86·44	17·10	..	..	..	..	..
23	„ …………………	495	17·00	2·30	88·08	..	..	..	..	..	791	16·00	2·50	86·48	15·10	..	..	..	..	..
24	Potatoes……………	495	17·00	2·30	88·08	..	..	..	..	..	861	19·40	2·30	89·40	17·00	..	..	..	..	..
25	Cabbage……………	495	17·00	2·30	88·08	..	..	..	..	..	743	17·70	2·70	86·76	15·60	..	..	..	..	..

SCOTLAND.—*Continued.*

Reference No.	The Trials were made by	Farming at	What kind of Soil.	What Manure was used, and How much per Acre.	Yield of Roots per Acre.	Length of time of Vegetation.
26	Mrs. Nicol	Monduff, Muchals, Kincardineshire	Brown loam	16 tons farmyard manure	15	145
27	Andrew Silver, Esq.	Muchals, Netherley, Kincardineshire	Grey loam, sandy subsoil	16 tons farmyard manure	12	153
28	John Crozier, Esq.	Durris, Drumoak, Kincardineshire	Loam overlying granite	Heavy dressing of farmyard manure, nitrate and superphosphate	19	151
29	Simon Mackenzie, Esq.	Newtonhill, Clatt, Aberdeenshire	Light soil, subsoil reddish loam	10 tons farmyard manure, 4½ cwt. potash manure	18	154
30	George A. Bruce, Esq.	Inchfield Farm, Inch, Aberdeenshire	Light brown loam, sandy subsoil	16 tons farmyard manure, 4 cwt. superphosphate, 1 cwt. muriate of potash	9	160
31	John Anderson, Esq.	Smithfield, Hazelhead, Aberdeenshire	Black loam, clay subsoil	20 tons farmyard manure, 2 cwt. mixed bones and ½ ton ground lime	15	158
32	James Forrest, Esq.	Netherhill, Farm, Pitfour Estate, Aberdeenshire	Rich deep loam, clay subsoil	20 tons farmyard manure and superphosphate	11	151
33	Messrs. A. Sutherland & Sons	Kinnernie, Dunecht, Aberdeenshire	Ordinary	Kainite and superphosphate	16	133
34	G. M. Russell, Esq.	Beechcroft, Premnay, Inch, Aberdeenshire	Clay loam, clay subsoil	Farmyard manure	27	161
35	James Milne, Esq.	Upper Craigwells, Netherley, Kincardineshire	Black, clay subsoil	2 cwt. crushed bones, 2 cwt. superphosphate, 6 tons farmyard manure	16	156
36	Alexander Gerard, Esq.	Newton Farm, Dunecht, Aberdeenshire	Clay	20 loads dung, 3 cwt. superphosphate, 1½ cwt. kainite, ½ cwt. sulphate of ammonia	23	150
37	Robert Reid, Esq.	Pheppie Burn, Muchalls, Kincardineshire	Clay loam, clay subsoil	16 tons farmyard manure	15	148
38	James Cant, Esq.	Whitehall, Insch, Aberdeenshire	Clay	,, ,,	16	159
	Average of the 26 Experiments in Scotland				15	161
	Average of the 38 Experiments in England and Scotland				16	163

Reference No.	Previous Crop.	Compared with Licht, Magdeburg.				Braune.					Aderstedt.					Vilmorin (blanche).				
		Average weight in grammes.	Sugar in 100 parts of Juice.	Non-sugar in 100 parts of Juice.	Purity.	Average weight in grammes.	Sugar in 100 parts of Juice.	Non-sugar in 100 parts of Juice.	Purity.	Sugar in 100 parts of Roots.	Average weight in grammes.	Sugar in 100 parts of Juice.	Non-sugar in 100 parts of Juice.	Purity.	Sugar in 100 parts of Roots.	Average weight in grammes.	Sugar in 100 parts of Juice.	Non-sugar in 100 parts of Juice.	Purity.	Sugar in 100 parts of Roots.
26	Oats	495	17·00	2·30	88·08	..	..	..	..	..	689	15·70	2·20	87·82	15·00	..	..	..	..	..
27	Corn....................	495	17·00	2·30	88·08	..	..	..	..	..	1190	18·80	2·80	87·04	16·30	..	..	..	..	..
28	Cabbage	495	17·00	2·30	88·08	..	..	..	..	..	913	18·40	2·20	89·32	15·90	..	..	..	..	..
29	Oats	495	17·00	2·30	88·08	..	..	..	..	..	711	19·70	2·90	87·17	17·00	..	..	..	..	..
30	,, ...	495	17·00	2·30	88·08	..	..	..	..	..	1024	16·40	2·30	87·70	15·10	..	..	..	..	..
31	Corn....................	495	17·00	2·30	88·08	..	..	..	..	..	813	16·40	3·00	84·54	15·20	..	..	..	..	..
32	Oats	495	17·00	2 30	88·08	..	..	..	..	..	871	15·30	2·20	87·43	14·50	..	..	..	..	..
33	,, ...	495	17·00	2·30	88·08	..	..	..	..	..	792	17·30	3·10	84·80	15·90	..	..	..	..	..
		Compared with Licht, Magdeburg.									Aderstedt.									
34	Oats	495	17·00	2·30.	88·08	..	..	..	..	..	911	16·30	2·60	86·24	15·10	..	..	..	..	..
35	,, ...	495	17·00	2·30	88·08	..	..	..	..	..	714	17·20	2·40	87·75	15·10	..	..	.	..	..
36	,, ...	495	17 00	2·30	88·08	..	..	..	..	..	1010	16·00	2·50	86·48	15·20	..	..	..	..	..
37	,, ...	495	17·00	2·30	88·08	..	..	..	..	..	742	16·10	2·40	87·03	15·30	..	..	..	..	..
38	Corn	495	17·00	2·30	88·08	..	..	..	..	..	888	17·90	2·90	86·06	16·10	..	..	..	..	..
		495	17·00	2·30	88·08	..	..	..	..	..	842	17·32	2·61	87·05	15·69	..	..	..	..	..
		..	..	..	..	..	..	..	..	..	996	17·50	2·63	87·03	15·93	..	..	..	..	..

THE MANUFACTURE OF SUGAR FROM BRITISH GROWN BEET.

By Sigmund Stein

(Sugar Expert, Liverpool).

(Continued from page 55.)

I now give you the balance-sheet of an English beet sugar factory. I must say at once that the first factory must not start with a very large quantity of beetroots, because at the first it would be best to work only such a quantity as would make the factory remunerative. It should be only the preparation and nucleus for a larger factory, therefore the first beetroot factory should only work 25,000 tons of sugar beetroots per campaign. This quantity could easily be grown on 1,600 to 1,700 acres. The price of sugar I have put a little higher than the present price (for reasons which I have put before you a few minutes ago). In manufacturing sugar, you do not get all the sugar in the form of refined sugar, but there is another quality, made from the residue, which is called "yellow sugar," and which is sold at a very handsome profit to the confectioner, baker, brewer, &c., and which finds a very ready market in this country.

MOLASSES.

The molasses is a very excellent feeding material, and could be well disposed of at 3s. 6d. per cwt., or the factory could use the molasses itself in making feeding materials for the farmer. This is done on the Continent, where the sugar factories do an excellent business in the manufacture of feeding stuffs.

SLICES.

The price of slices, or cossettes, as they call them abroad, I have put at the present market value of 10s. per ton, and inquiry has confirmed my view that they can be easily disposed of at this price.

FINANCE.

Our factory should have a capital of £60,000 to £80,000; £80,000 would be better, leaving a larger working capital at disposal. Should however, there be any difficulty in obtaining this latter sum, there would be sufficient funds if a sum of £60,000 were available, but, of course, certain arrangements would have to be gone through with banks, or sugar consumers, in respect of advances which would supply the factory with the necessary working capital. But I think that such a contingency as that of begging for another £20,000 capital should not, and never will occur.

I base, therefore, my calculations on a capital of £80,000, which I distribute as follows:—

	£.
Machinery (costing)	30,000
Building of factory	8,000
Leaving a working capital for paying for roots and working expenses of	42,000
	£80,000

Balance-sheet of a Beet-sugar Works.

Capable of working 25,000 tons of beetroots in a campaign, or 300 tons of beet per day of 24 hours (working 83 days):—

Dr.	£	s.	d.	*Cr.*	£	s.	d.
Cost of beetroots, including expenses, 25,000 tons at 25s. per ton	31,250	0	0	3,000 tons refined sugar, produced at 13s. (in bond) ..	39,000	0	0
5 per cent. depreciation	1,500	0	0	2 per cent. (500 tons) of yellow sugar at 11s. 6d. (in bond)	5,750	0	0
Profit	17,500	0	0	2 per cent. molasses (500 tons) at £3 10s. per ton	1,750	0	0
				30 per cent. slices 7,500 tons at 10s. per ton	3,750	0	0
	£50,250	0	0		£50,250	0	0

Here we have a gross profit of £17,500 on a capital of £80,000. If you take from this £17,500 a sum of £1,500 for any other expenses or any discrepancies which may occur, it leaves you £16,000, which would pay 20 per cent. profit on a capital of £80,000.

Now, I want to refer you to the different books I have published, and I must explain the discrepancies between this and my former calculations. In former years I only calculated on raw sugar, leaving out the whole profit of refining. This has all to be taken into consideration, especially as science has kept pace with the times, and we have made many improvements.

It will be opportune to mention the opinion of a gentleman regarding the establishment of a beet-sugar factory in this country; I mean Mr. George Martineau, C.B., who is one of the British delegates to the Brussels Commission. Mr. Martineau can speak authoritatively, having had many years' experience as a sugar refiner, and having studied the beet-sugar question thoroughly. Mr. Martineau, in regarding this question, speaks as follows:—

"The final consideration with regard to the sugar position created by the abolition of bounties is, perhaps, one of the most important. It was shown that beet-sugar could be grown in this country with as much success as on the Continent; but the bounties stood in the way of further progress. That impediment having been removed, there is no reason why we should not produce from our own land, and with our own labour, some of the sugar we consume. The country, I know, is absolutely apathetic on the subject, ignorant of the blessing that such an industry would bring to the British farmer, but, in some cases, even sufficiently prejudiced to declare that a scheme of this kind would be impracticable. There must be no experimenting on a small scale, the thing must be done with all the well established improvements, and on such a scale as to make success a certainty by reducing cost of production to a minimum. The very best land must be chosen, and plenty of it, well situated with regard to rail and water carriage, and with the certainty of obtaining a full supply of roots, cultivated in the most approved fashion, and contracted for in advance for several years. Under such circumstances, we shall have a new industry—agricultural and manufacturing, of the very first importance. One successful factory will show the way to hundreds more, and we shall again hold up our heads as agriculturists with a real home industry. To make the machinery for such an industry will require another new departure. The growing of the roots, we shall soon discover, will give us new ideas of farming and new energies on the land. Crops all round will improve, cattle will multiply, the railways and canals will discover new employment, and the labourer will go back to the land. This is a dream, but it can be made a reality."

There you have the mature view of a great authority.

I myself have worked very hard for this question (as I mentioned above), by voice, by writing to the papers, and by publishing numerous books and pamphlets, and yet since I started this campaign we have sent abroad not less than £300,000,000 sterling, that might well have been retained in this country. I hope and wish that my appeal may not have been in vain, and if thereby I shall have done anything to introduce this gigantic industry into the country which has adopted me as a citizen, I consider myself repaid for the great sacrifice of time, labour, and the outlay of a great deal of money, all of which I have devoted to this cause.

You have heard what I have had to say, and it is now for you to help me in answering the question which I have put before you this evening. I hope your answer will be unanimous in saying: "It is advisable and profitable to cultivate sugar-beet, and to erect our own sugar factories, so that we can cover our own demand for sugar."

Discussion.

The Chairman said he did not pretend to be either an agriculturist or an expert sugar grower, but he was present merely in the capacity of a humble landowner who had taken some interest in the question through reading about it seven or eight years ago. He at once realised that although considerable experiments had been carried on with regard to sugar-beet growing in other parts of England, Scotland, and Ireland, nothing had been done in Warwickshire, where he resided. He thought he should like to make an attempt, so he began by growing beet on small plots on his own account, and the experiments were satisfactory, but he thought that probably a certain amount of suspicion might be attached to a landlord's experiment, so he invited some of his tenants to co-operate with him. Accordingly, four of his tenants each grew about an acre of beet in the middle of a crop of mangold-wurzel, in order that they might be sure it was a real result of what might be called general agriculture. The roots were weighed at the end of the season each year, and samples of each root grown were sent up to Mr. Stein for analysis, the results being carefully tabulated and published. The experiments were continued for several years. Not the least interesting portion of the experiment was that two of the years, 1902 and 1903, were very short of sun; and although some of the most experienced agriculturists had told him over and over again that it was perfectly useless to attempt to grow sugar-beet in England because there was not sufficient sun to develop the necessary saccharine qualities, yet in those particular years there was hardly any difference whatever in the saccharine contents. He thought the experimental stage had now been carried far enough. Obviously the first thing to do before attempting anything on a large scale was to see whether beet could be grown in this country of a sufficiently good quality to enable people to treat it on a commercial scale, and he thought that had been satisfactorily proved experimentally. At the present moment, however, they were at a full stop. The farmers said it was no use growing beetroot because there was no factory to send it to; and, on the other hand, capitalists as yet had not put up anything in the nature of a factory, because they said there was no beetroot grown in the country. There was another thing which was also rather disheartening to capitalists at the present moment. The first objection, the sugar bounties, had vanished. While sugar bounties existed and were liable to variation, British capitalists could not be certain that, if they embarked a large amount of capital in the manufacture of beet-sugar, the bounties would not be altered to their disadvantage, and they would thereby be left with an unprofitable industry. The wet blanket which was hanging over them now was the question of the excise. When the Sugar Duty Act was passed a few years ago, power was only taken to impose an import duty, because no sugar was made in this country. He had ascertained on the highest authority that there was at the present moment no power, without going to Parliament for special powers, to impose an excise duty, but, in accordance with the fiscal system which all worshipped so reverently, supposing anything in the nature of a sugar industry was started it would be the bounden duty of the Chancellor of the Exchequer at once to ask Parliament for the protection of the revenue and the maintenance of the fiscal system, and to clap on an excise duty equal to the import duty, viz., 4s. 2d. a cwt., which would effectually strangle the new industry almost before it was born. Even if the Chancellor of the Exchequer were to do as Lord Nelson did at the Battle of Copenhagen—put his telescope to a blind eye—when asked to look at the sugar industry that was growing up, he could not be expected to do so for very long, and even although the sugar industry might not perhaps be taxed for a short time it would always be labouring under the fear of being eventually taxed. While that condition of things existed it was obviously impossible to place the matter, in a commercial sense, before anybody who would be likely to put down the requisite capital. It was a very great pity that something could not be done for the furtherance of the industry. Sugar was successfully grown in every portion of the Continent of Europe, in Sweden, and in the United States, and yet England alone did nothing. He believed it was a fact that wherever it had been grown it had improved the agriculture of the district, because sugar-beet could not be grown successfully without doing the land well, and if that was done for one crop it obviously benefited the succeeding crops. In referring to the labour question, Mr. Stein had said that one reason why beet was not grown in this country was because they did not want to deal with the unemployed question. He fully agreed with Mr. Stein that if an industry could be started on a large scale (of course, it would be many years before it grew to be a large industry), it would undoubtedly give a great amount of employment on the land where very little labour was used at present, but the question of labour was largely a question of wages. If the farmers could afford to pay really satisfactory wages to the men whom they employed on the land there would be no difficulty, he thought, in getting labour; and the question of wages was entirely governed by the price which the manufacturers could afford to pay the farmers for their beetroot, while the amount which a farmer could afford to take for his beetroot was governed also, to a great extent, by the size of the crop which he could grow. He had hitherto looked upon twelve tons to the acre as being a safe average to take, because it was better in such matters to under-estimate rather than to over-estimate. Mr. Stein, on the other hand, thought fifteen or sixteen tons was a safe average. If that was right, so much the better. Hitherto he had reckoned upon being able to get £1 a ton for clean beetroot for the farmers; Mr. Stein thought 18s. would pay them well, and certainly if they could grow crops according to the author's balance-sheet, and make £7 10s. an acre on their beet crop, there would be nothing to complain about—in fact, he would go so far as to say that if they could make half that amount, £3 15s. per acre net profit, there were many farmers in the country who would be only too pleased to jump at it. There was no doubt it was a great industry, and now that prices seemed to be settling down and becoming more normal than they were after the Sugar Convention abolished the bounties, when prices fluctuated so widely, the time had arrived when the people might seriously consider the matter, and anybody who would come forward and find the necessary capital for the starting of the industry would be a benefactor to the whole of the agriculturists of the country. The only thing required was for the experiment to be successful. Some years ago an attempt was made to grow sugar at Lavenham, but, unfortunately, it proved to be a financial failure, and whenever you talked of sugar now-a-days to some people, they immediately threw Lavenham in your face, and said the attempt which had been made had failed. But many things had happened since then. The beetroot had vastly improved; the percentage of sugar obtained from beetroot was very largely increased, and consequently a larger profit could be made from the same crop. The machinery and plant for treating the sugar had also improved, and there were much better methods of traction, a most important consideration. With motors, the growers were not tied to their own locality, so that if their farms were not favourably situated in regard to water carriage, there was no reason why, with a properly organized system of motor carriage, they should not be able to transport their beetroots at a very reasonable rate to a much larger radius round about than was formerly the case. The more one learned from those who were thoroughly acquainted with the subject, the more one felt there was no reason whatever why, because the experiment failed at Lavenham a good many years ago, it should fail if started now. The one thing which blocked the way was the fiscal goddess which was reared up and which had to be worshipped; and until some sort of guarantee was obtained that a heavy excise duty would not be put on sugar, but that some encouragement would be given by the powers that be, it seemed to him almost hopeless to attempt to get people to go in for sugar beetroot growing on a large commercial scale.

Dr. Gustaf Schach-Sommer stated that in the year 1889, having read of the experiments of Mr. Newlands and Professor Sutherland, he was encouraged to try the experiment of growing sugar beetroot in England, Scotland, and Ireland, and subsequently Mr. Stein came over to England and assisted him in further experiments up to the year 1895. When he started his experiments in 1889, the average price of beetroot sugar was 15s. 5d., and it gradually dwindled until in 1895 it was only 9s. 7d. He thought it was then time to stop experimenting, because the farmers who had planted beetroot on his advice, wrote and asked him what they were to do with their crops, and he was obliged to advise them to feed their cattle on them. Mr. Stein had asked how it was that English people did not grow their own beet and make their own sugar. It seemed to him the answer was very simple. It took eight tons of roots, or possibly 7¾ tons, to make a ton of sugar, which was a 12 per cent. yield; and if £1 a ton was paid to the farmer for his crop, it meant that the manufacturer had to pay £8 for the roots for a ton of sugar, without taking into consideration the manufacturing expenses and carriage. In his opinion, the author's statement that 15 tons of roots could be grown per acre was exaggerated, the average figure being nearer 12 or 13 tons. Mr. Stein had mentioned that he had known 40 tons to be grown on an acre. If that was the case he (Dr. Sommer) knew several museums which would be glad to have specimens of the crop. But, even taking Mr. Stein's statement that 15 tons of beet could be grown to the acre, for which the farmer received £1 per ton, he believed it was the fact that an average crop of mangold-wurzel was 30 tons to the acre, yielding 14s. to 15s. a ton, which worked out at £18 15s. per acre against £15 per acre for beet, If a farmer could get more profit by growing mangold-wurzel, why should he grow sugar-beet? Mr. George Martineau, who assisted the British representatives at the Brussels Sugar Convention, had published in his well-known book, the statement that the cost of beet sugar was 10s. per cwt. if 16s. 8d. per ton was paid for the roots. Therefore in answer to Mr. Stein's question, in his opinion the farmer did not take up the industry because the profit he could make out of growing sugar beetroot at present prices was not remunerative enough. He did not see any reason why sugar should advance in price in the next few years, and he did not think, therefore, the capitalist had any justification in risking his money in an enterprise which on paper to-day showed a net loss of practically 2s. per cwt.

Mr. B. E. R. Newlands remarked that the Chairman had stated that the Lavenham works were run at a loss, and therefore had to stop. That was not the case at all. Lavenham never lost money until the war occurred between Germany and France, when the bounties were very greatly increased owing to the increase of duty, making it impossible to compete; but up to that time Lavenham was carried on successfully from a financial point of view. Mr. Duncan tried to induce agriculturists in every county in the United Kingdom, and particularly capitalists, to start growing sugar beetroot, because Mr. Duncan did not go into the manufacture of sugar with the idea of making money, but simply for the purpose of inducing other people to go into the business. After very mature study, extending over many years, he (Mr. Newlands) had arrived at the conclusion that beetroot sugar would not be profitably produced in England unless the growers were given the benefit of the 2s. 6d. per cwt. surtax which the growers on the continent had, and there was not the slightest chance of getting that benefit. On the other hand there was more probability of the duty on sugar being taken off, and obviously, if that was done, the growers would not be able to get the surtax of 2s. 6d. Again, if the home growers were allowed a surtax of 2s. 6d., what would the West Indies and the other Colonists say? They would also want the 2s. 6d. off, which it would be impossible to give, because, under the Convention, England had no right to treat her Colonies differently to the way she treated foreign countries. He would give a good many years of his life if he could see the sugar beetroot industry at work in England, but the chances were absolutely nil unless a very radical alteration occurred in the political aspects of the time. The Government in process of formation would probably reduce the sugar duties to nothing, and the chance of establishing a sugar industry in England would then absolutely vanish. If, on the other hand, English growers were placed in the same position as those of the other Powers who signed the Convention, and were paid 2s. 6d. a cwt. surtax, he would put money into the scheme and recommend his friends to do the same. But under the present circumstances it was no use; and even with the genius of Mr. Stein it could not be done.

Mr. Stein, in reply to Dr. Schach-Sommer's statement that the beetroot gave only a 12 per cent. yield of sugar, said that the official statistician to the German Empire in his report for the present year, issued only in the previous week, stated that the yield in Germany was 14·7 per cent. Further, the roots in Germany for the next season had been contracted for at 14s.; and he had offered to grow 30,000 tons of sugar-beet in Lincoln at 18s. a ton. The statement had been made that Mr. Martineau was very pessimistic about the prospects of growing sugar-beet in this country, but, as a matter of fact, he had quoted in the paper a long extract from Mr. Martineau showing that he held exactly the opposite opinion. Mr. Martineau had stated within the last few weeks that, now that the bounties were abolished, sugar factories should be started in England. It had been suggested that the yield of roots per acre was only 12 tons, but the average was quite 15, and even 18 and 20. He had received such figures from farmers who grew large crops of beet, and on the five or six-acre plot of the Liverpool Corporation the roots had been actually weighed, and came to about 25 tons per acre One speaker had asked if beetroots could be grown for several years in succession. A gentleman at Leamington, in Hampshire, had told him that he grew sugar beetroots for 25 years on the same plot. Dr. Schach-Sommer had said that the salvation of the British farmer was to grow mangold-wurzel, which yielded 30 tons to the acre. As a matter of fact, the Board of Agriculture returns for the last 10 or 15 years showed that the average yield in Great Britain and Ireland was only 18 tons; while instead of it fetching 14s. or 15s. a ton, in the opinion of Mr. Cave, the estate agent of the Chairman, it only realised 11s. In addition to that, sugar beetroot was contracted for five or ten years in advance, and the same ready market could not be obtained for mangold-wurzel. He quite agreed with the statement that it cost 9s. to produce sugar from the beetroot. The present price of sugar was 8s. 6d., and if it went up another 1s., which was quite possible, it would pay to make sugar in this country.

Correspondence.

COOLIE LABOUR.

To the Editor of "The International Sugar Journal."

Sir,—Will you permit us, through the medium of your columns, to deprecate the use which is being made of Imperial questions for purely Party purposes. We refer more especially to the question of immigration into our Colonies. While one of the contesting political parties is condemning in no measured terms the system of importation of Chinese coolies into South Africa, the other is unjustifiably dragging into the controversy East Indian coolie immigration into British Guiana. Without wishing to suggest in the slightest degree that there is any just ground of objection to the system of importation of Chinamen into South Africa, we desire emphatically to state that that system differs very materially and in many important respects from that which obtains in British Guiana, and which has received the sanction of successive Governments, both Liberal and Conservative. We venture to set out below, for purpose of comparison, the following points drawn from the respective Ordinances and regulations at present in force, which, we think, clearly show the wide differences between them:—

South Africa.	British Guiana.
The Chinese Immigrant.	*The East Indian Immigrant.*
(*a.*) Must not be employed in skilled labour and certain trades so long as he remains in the Colony.	(*a.*) If he shows aptitude, can be employed as a tradesman and mechanic or in other skilled work in the factory during his indenture. There is no

	restriction whatever after his indenture ceases. During his indenture, he frequently saves money and purchases cattle, which are looked after for him during his work at the expense of the estate.
	WEST INDIA.
(*b.*) Must be sent back to China at the termination of his indenture.	(*b.*) Has the option of remaining in the Colony. He can receive Crown lands instead of his half return passage. He is encouraged to remain on the estate, where he receives free housing, medical attendance, and pasture for his cattle, of which, and other privileges, a large number avail themselves. These coolies have become a most important and useful portion of the population. The Colony has derived incalculable benefit from their industrious and law abiding citizenship, and they in their turn have become prosperous to an extent hardly possible in their own country.
(*c.*) Must not leave the premises where he is employed without a permit.	(*c.*) Must not leave the estate without a permit, which can easily be obtained, but as the estates vary from 1000 to 10,000 acres in size, and are communities in themselves, this is no hardship.
(*d.*) Summary jurisdiction is exercised by the superintendent and inspector.	(*d.*) Proceedings for breach of contract can only be taken before the ordinary magistrates of the Colony. The immigration authorities only enquire and report to the Governor on grievances.
(*e.*) The Chinese immigrant may be accompanied by his wife or not at option.	(*e.*) The Indian immigrants must be accompanied by 40% of women.

In conclusion, may we say how much we deprecate the question of coolie immigration being submitted to the judgment of an excited electorate, with the possible effect of discredit being thrown unjustly, though perhaps unintentionally, upon a system which has been an inestimable blessing to those coolies who have availed themselves of it, and a means of introducing an industrious and intelligent population to one of our oldest Colonies. It cannot fairly be said that one Party more than another is especially responsible for the British Guiana system, which has now been in active operation for more than half a century.

We are, your obedient servants,
N. LUBBOCK, Chairman.
ALGERNON E. ASPINALL,
Secretary.

The West India Committee,
15, Seething Lane, London, E.C.
10th January, 1906.

BRITISH BEETROOT SUGAR.

TO THE EDITOR OF "THE INTERNATIONAL SUGAR JOURNAL."

Sir,—I have read with great interest the details you give in your January issue on this important question—a subject to which I devoted considerable attention and labour more than thirty years ago. As I have been a regular reader of the foreign Journals devoted to the beetroot industry almost ever since they were started I am fairly well qualified to judge how far the industry is likely to sustain successfully a competition with cane sugar now that free trade has been restored. As to the possibility of growing good crops of beetroot in this country, my investigations in 1871 proved it conclusively. Many farmers in East Kent, Suffolk and Lincolnshire were quite convinced; especially the late Mr. Algernon Clarke, of Long Sutton in Lincolnshire, who was for many years a constant writer on Agricultural matters and Secretary to the Central Chamber of Agriculture. After going into the matter very fully with me he contributed a paper to the Journal of that Society, in the year 1871, to which I should recommend members of the Society to refer. I did not agree with all his conclusions, but as a farmer's view of the question the paper is most valuable.

Mr. Mason's letter in the *East Anglian Times* is the most valuable contribution to the literature of the subject that I have read in recent years, because he has pursued the right and only course that should be taken in arriving at reliable information for future guidance. I have visited sugar factories and engineering works in most of the European countries, and therefore I can confirm his view of the essential importance of getting at the real facts and details from personal minute inspection and conversation on the spot. This he has done with great thoroughness and intelligence. When a company is actually in process of formation it will be necessary to supplement the information he has already collected with many further details before embarking on practical work.

The production of beetroot sugar in this country would never interfere with our Colonial brethren because we consume a great deal more sugar than they can ever send us. The competition must be with the Continent and with foreign cane sugar countries. The British producer will always have the advantage of being close to his market, and furnished with a good supply of cheap coal.

Preferential duties must not enter into the calculation. We must first of all be convinced that we can compete advantageously on equal terms.

I am, Sir, yours faithfully,
GEORGE MARTINEAU.

Gomshall, 24th January, 1906.

PUBLICATIONS RECEIVED.

BEET SUGAR MANUFACTURE AND REFINING. VOL. I. EXTRACTION AND EPURATION. By Lewis S. Ware (Editor, "The Sugar Beet"). xxvi. + 543 pages, and 262 figures. New York: John Wiley & Sons. London: Chapman & Hall, Ltd. Price, $4·00.

When the Editor of an American beet sugar monthly has his headquarters for some 30 years in Paris—a centre of the European beet sugar industry—it is only natural to assume that he is well *au fait* in all the details of a specialized industry as carried on in France, Germany and Austria. This supposition is moreover strengthened when we learn that during the last three decades he has examined the working of nearly three hundred factory plants, and made thousands of pages of notes collected in all the principal beet sugar countries. The outcome of it all is a treatise on Beet Sugar Manufacture and Refining, of which the first volume, dealing with Extraction and Epuration, has just been issued. We have here a book which not only tells you what the best authorities say, but which gives the conclusions to be drawn from the pros and cons expressed by these authorities. The learner when confronted with a host of variant views, each bearing the hall-mark of some or other expert, must needs feel embarrassed; he wants to be told not so much how many different ways there are, but rather which way to follow for himself. When experts disagree, who shall decide? We think a reasonable answer is: An outside expert; meaning thereby an onlooker who has grown expert by watching the game. If this point be conceded, then it must be confessed it would be difficult to find a more competent man—in Anglo-Saxon countries—than Mr. Ware for placing before us all that is best of the science of beet sugar manufacture as carried on in Europe. His book will certainly be a valuable addition to existing literature on the subject; indeed, it should mark an epoch in the issue of such literature.

The volume is divided into three parts. Part I. treats on Preliminaries, such as Delivery, Siloing, Transportation, Beet Washing. Part II. deals with extraction which is mainly that of Diffusion. And Part III. concerns Epuration. The names of authorities quoted figure on every page, and there are some 262 line drawings to illustrate the text. Altogether, it is a book which should be obtained by everyone who aspires to attain a full knowledge of beet sugar manufacture.

We would venture to express a word of criticism as regards the author's nomenclature. We have noted a tendency on the part of some English-speaking persons, who study much abroad, to incorporate into their own language facsimiles of foreign technical words. This is unavoidable if no correct equivalent is forthcoming, but when we already possess a suitable word, let us stick to it, and not introduce another foreign term into our vocabulary. Is it necessary to import the word "epuration" from the French? Will not "purification" amply describe all that it implies? Or take the word "cossettes." No novice is likely to know this term, but call it "beet-slices" and he will not need to pause and inquire what is meant; surely here simplicity is preferable to obscurity. Finally, we hope that when Mr. Ware issues his final volume, or volumes, and deals with the separation of the crystals from the molasses, he will render the French "turbine" by "centrifugal," and not, as we have sometimes seen it put, by "turbine." First, because "centrifugal" is more scientifically correct as describing the principle of the mechanical process: second, because "turbine" is fast becoming known to English-speaking people—and in a year or two will be exclusively so used—as the name of the steam rotary motor which forms the new system of marine and dynamo propulsion. In fact, it will not be long before people will talk of "going on board the turbine for New York," as they have hitherto talked of "steamers." We therefore think it would be as well if the use of this word were confined to its newer interpretation, and not used for describing a medium for the employment of centrifugal force.

A HANDBOOK FOR CANE SUGAR MANUFACTURERS AND THEIR CHEMISTS. By Guilford L. Spencer, D.Sc. Fourth Edition, re-written and enlarged. New York: John Wiley & Sons. London: Chapman & Hall, Ltd. 1906. 16mo., Morocco, 12s. 6d.

This much enlarged edition contains an excellent introduction to the processes of sugar manufacture, the machinery employed, and to the current technical terms used. These fifty odd pages should prove invaluable to the chemist on first taking up his duties in the factory, for, as stated in the preface, "the proper control of a sugar factory by the chemist requires a knowledge of the methods of manufacture, in addition to a chemical training."

The general remarks on chemical control explain the relative importance of the analytical methods described, and the author advises the factory chemist "to determine when he may properly, to some degree, sacrifice accuracy for the sake of promptly obtaining approximate figures for immediate use." An example of this is given in the control of the sugar-boiling.

As regards new methods of analysis, Horne's process of "dry defecation" is recommended in the analysis of juices and sugars. A modification of Clerget's method, as specially adapted for cane products, is described in full with examples worked out.

Of new apparatus, the most interesting is Hyatt's Cane Reducer, by means of which samples of whole cane or of megass can be rapidly "reduced to a fine sawdust and hair-like fibre" without loss of moisture. This appliance greatly facilitates the direct analysis of the cane, but, except in diffusion work, the difficulty of sampling the cane remains the more serious problem. Recent models of polariscopes and accessories are described and illustrated under the section dealing with optical methods of analysis. The errors of this method are discussed, and Wiley's correction for temperature recommended.

An interesting chapter on the composition of the sugar cane and molasses is contributed by Dr. C. A. Browne, concluding with descriptions of a few of the abnormal constituents of sugar cane products.

The bulk of the volume is taken up with the analytical work required in routine chemical control, to which is added selected methods of analysis of limestone, lime, sulphur, lubricating oils, flue gases, and water supply.

This information is packed into a neat pocket volume, the style of which leaves nothing to be desired.

The Colonial Exhibition 1905: Report of the Exhibition Committee, Awards of the Judges and Full Descriptive Account of the West Indian Court. London: The West India Committee, 15, Seething Lane, E.C. Price, 6d. net. This consists of 50 quarto pages in a red cover, profusely illustrated with views of various courts and exhibits, and forms an interesting souvenir of the Exhibition.

MONTHLY LIST OF PATENTS.

Communicated by Mr. W. P. Thompson, C.E., F.C.S., M.I.M.E., Chartered Patent Agent, 6, Lord Street, Liverpool; and 322, High Holborn, London.

ENGLISH.—Application.

26334. A. Vosskohler, Magdeburg, Germany. *Improvement in machine for making sugar goods.* (Complete specification.) 18th December, 1905.

ABRIDGMENTS.

19894. C. Schuler, Grevenbroich (Rheinland), Germany. *Centrifugal separators.* 2nd October, 1905. This invention relates to a centrifugal apparatus with bottom that can be lowered, wherein the drum is not attached to the shaft, and receives its motion from the drum bottom, which is formed as friction disc or other similar driving device, so that on lowering the drum bottom, the driving of the drum automatically ceases, while the drum bottom continues to rotate with the full speed.

27289. A. KOLLREPP, Charlottenburg, and A. WOHL, Dantzig, both in Germany. *Improvements in and relating to the purification of sugar solutions.* 14th December, 1904. This invention relates to a process for purifying saccharic solutions by the electrolytic separation of alkali, and subsequent treatment of the acid solutions with lead sucrate, lead hydroxide, or other readily attackable basic lead compounds.

26368. A. J. JOHNSTON and C. K. JOHNSTON, both of Liverpool. *Improvements in apparatus for measuring flour, cocoa, and other substances of a pulverulent and granular nature, and filling them into bags or other receptacles.* 3rd December, 1904. This invention has for its object an apparatus wherein given quantities of flour, cocoa, and other pulverulent substances can be measured automatically, and filled into bags or other receptacles required, with much greater economy in time and labour than by the usual hand method.

GERMAN.—ABRIDGMENT.

164111. AUGUST NEUMANN, of Berlin, *Vacuum boiling down apparatus in which the material boiled is displaced by means of deflectors into separate circulating currents.* 4th November, 1904. This boiling down apparatus in which the material boiled is distributed into circulating currents which move apart from one another by means of deflectors, is characterised by the combination of a circulation pipe which is connected to the lower end of the heating arrangement, and enlarges funnel-shaped upwards, with a construction, enclosing this circulation pipe, of uniform sized bell sockets, rings, or the like, which are separated from one another by annular apertures for the passing over of the material or the substance to be boiled.

NOTE.—Copies of all published specifications with their drawings in these lists can be obtained from W. P. Thompson & Co., 6, Lord Street, Liverpool, at One Shilling a copy for English or American Patents, and Two Shillings for German. In ordering please give number and date.

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WEEKLY STATEMENT OF COMPARATIVE

For the last Fifty-two weeks compared

	German Beetroot 88 o/o Prompt, free on board.						French Crystals. No. 3. c.f.i.			West India. Good Brown.			Java afloat. No. 15 and 16.		
	1905.		1904.		1903.		1905.	1904.	1903.	1905.	1904.	1903.	1905.	1904.	1903.
Jan. 6..	14/5	15/1½	8/4¾	8/3½	8/0¾	8/-	--	10/1½	—	—	—	--	15/10½	9/3	9/4½
13..	15/1½	15/11¾	8/3½	8/1	8/-	8/1	—	10/-	—	—	—	—	16/10½	9/1½	9/4½
20..	15/11¾	16/0¾	8/1	7/10¼	8/1	8/-	—	10/-	—	—	—	—	17/3	8/9	9/4½
27..	16/0¾	16/-	7/10¼	7/10¼	8/0	7/10½	—	9/10½	—	—	—	—	17/1½	8/7½	9/4½
Feb. 3..	16/-	15/6½	7/10¼	7/9½	7/10½	7/10½	—	9/6	—	—	—	—	16/10½	8/4½	9/4½
10..	15/6½	15/2	7/9½	7/9	7/10½	7/11¾	—	9/6	—	—	—	—	16/7½	8/6	9/4½
17..	15/2	15/1½	7/9	7/11	7/11¼	8/2	—	9/7½	—	—	—	—	16/-	8/7½	9/4½
24..	15/1½	15/4½	7/11	8/0	8/2	8/4	—	9/9	—	—	—	—	16/-	8/7½	9/6
March 3.	15/4½	15/3¼	8/0	8/2½	8/4	8/4½	17/-	9/9¾	—	—	—	—	16/-	8/7½	9/6
10..	15/3¼	15/-	8/2½	8/3	8/4½	8/5¼	16/9	9/10½	—	—	—	—	15/10½	8/10½	9/9
17..	15/-	14/7¾	8/3	8/3½	8/5¼	8/3¾	16/6	10/-	—	—	—	—	15/7½	8/10½	9/10
24..	14/7¾	14/5¼	8/3¼	8/5½	8/3¾	8/2¼	16/6	10/2¼	—	—	—	—	15/4½	9/1½	9/10½
31..	14/5¼	14/6½	8/5½	8/6½	8/2¼	8/2¼	16/6	10/4½	—	—	—	—	15/3	9/3½	9/7½
April 7..	14/6½	14/5¼	8/6½	8/6	8/2¼	8/3	16/6	10/4½	—	—	—	—	15/3	9/4¼	9/7½
14..	14/5½	14/0¾	8/6	8/5½	8/3	8/5	16/6	10/5¾	—	—	—	—	15/4½	9/5¼	9/7½
21..	14/0¾	13/1¼	8/5½	8/7½	8/5	8/4½	16/6	10/6¾	—	—	—	—	14/10½	9/5¼	9/10½
28..	13/1½	12/9¾	8/7½	8/9½	8/4½	8/4	Nom.	10/9	—	—	—	—	14/6	9/8	9/10½
May 5..	12/9¾	12/1½	8/9½	8/11½	8/4	8/3½	Nom.	10/11¼	10/-	—	—	—	14/6	9/9¾	9/10½
12..	12/1½	11/10¼	8/11½	9/2	8/3½	8/4¼	Nom.	11/2¼	10/-	—	—	—	13/9	10/3	9/10½
19..	11/10¼	11/8	9/2	9/6½	8/4¼	8/3¼	Nom.	11/3	10/-	—	—	—	13/6	10/4½	9/10½
26..	11/8	11/11½	9/6½	9/4¼	8/3¼	8/2¾	Nom.	11/6¾	10/-	—	—	—	13/6	10/4½	9/10½
June 2..	11/11½	11/9¾	9/4¼	9/2	8/2¾	8/1½	Nom.	11/4½	9/9	—	—	—	13/3	10/6	9/10½
9..	11/9¾	11/11½	9/2	9/0½	8/1½	8/0¼	Nom.	11/2¼	9/9	—	—	—	13/3	10/5¼	9/7½
16..	11/11½	11/9¾	9/0½	9/1¼	8/0¼	7/11¼	Nom.	11/3¼	9/9	—	—	—	13/3	10/3	9/7½
23..	11/9¾	11/9½	9/1¼	9/3	7/11¼	7/8½	Nom.	11/3	9/9	—	—	—	13/1½	10/3	9/6
30..	11/9½	10/11½	9/3	9/4¼	7/8½	7/9¼	Nom.	11/3	9/9	—	—	—	12/10½	10/3	9/4½
July 7..	10/11¼	10/6	9/4¼	9/7¼	7/9¼	7/10¾	Nom.	11/3¾	9/9	—	—	—	12/9	10/6	9/4½
14..	10/6	10/2½	9/7¼	9/8	7/10¾	7/11½	Nom.	11/3¾	9/9	—	—	—	11/9	10/6	9/4
21..	10/2½	10/11½	9/8	9/8½	7/11½	7/11½	Nom.	11/4½	9/9	—	—	—	11/9	10/6	9/6
28..	10/11¼	11/-	9/8½	9/9½	7/11½	8/0½	Nom.	11/4½	9/9	—	—	—	11/9	10/9	9/6
Aug. 4..	11/-	10/6	9/9½	10/1¼	8/0½	8/2¾	Nom.	11/8¼	Nom.	—	—	—	11/6	11/-	9/7
11..	10/6	10/1½	10/1¼	10/5¾	8/2¾	8/3¾	Nom.	11/9¾	10/-	—	—	—	11/6	11/3	9/9
18..	10/0½	9/5	10/5¾	10/6	8/3¾	8/5½	Nom.	12/0	Nom.	—	—	—	11/6	11/3	9/10
25..	9/5	9/1½	10/6	10/6½	8/5½	8/5¾	11/3	12/0	Nom.	—	—	—	11/-	11/4½	9/10
Sept. 1..	9/1½	8/9	10/6½	10/8	8/5¾	8/5½	10/7½	12/1½	10/3¾	—	—	—	10/3	11/7½	9/10
8..	8/9	8/7	10/8	10/7½	8/5½	8/5¼	10/7½	12/2¼	10/5¼	—	—	—	10/3	11/9	9/10½
15..	8/7	8/5½	10/7½	10/6	8/5¼	8/5¾	10/5¼	12/1½	10/5¼	—	—	—	10/0	11/9	9/10½
22..	8/5½	8/8	10/6	11/0	8/5¾	8/4½	10/6¾	12/10½	10/3	—	—	—	9/9	11/10½	9/10½
29..	8/8	8/7½	11/0	11/2	8/4½	8/5¼	10/7½	13/-	10/3	—	—	—	9/9	12/4½	9/10½
Oct. 6..	8/7½	8/9½	11/2	11/1¼	8/5¼	8/9½	10/6	Nom.	10/3	—	—	—	9/9	12/3	9/10½
13..	8/9½	8/8¼	11/1¼	10/11¼	8/9½	8/9¾	10/6	—	10/2¼	—	—	—	9/7½	12/3	9/10½
20..	8/8¼	8/4¼	10/11¼	11/-	8/9¾	8/9¼	10/0¾	—	12/2¼	—	—	—	9/7½	12/3	9/10½
27..	8/4¼	8/3	11/-	11/1½	8/9¼	9/6	10/-	—	10/2¼	—	—	—	9/1½	12/4½	9/9
Nov. 3..	8/3	8/0¼	11/1½	12/10¾	9/6	8/7	9/7½	—	10/1½	—	—	—	9/-	13/3	9/7½
10..	8/0¼	8/0½	12/10¾	13/9	8/7	8/6	9/8¼	—	10/1½	—	—	—	9/-	14/3	9/7½
17..	8/0½	8/2½	13/9	14/1	8/6	8/5¼	10/-	—	10/1½	—	—	—	9/-	15/3	9/7½
24..	8/2½	8/5¼	14/1	14/0½	8/5¼	8/4½	10/4½	—	10/1½	—	—	—	9/3	15/3	9/4½
Dec. 1..	8/5¼	8/3	14/0½	14/1	8/4½	8/4	10/-	—	10/1½	—	—	—	9/3	15/4½	9/4½
8..	8/3	8/3½	14/1	14/5	8/4¼	8/4	10/3	—	10/1½	—	—	—	9/3	15/4½	9/4½
15..	8/3½	8/2	14/5	13/9¾	8/4	8/5	10/0¾	—	10/3	—	—	—	9/3	15/4½	9/4½
22..	8/2	8/1½	13/9¾	14/2½	8/5	8/4½	10/0¾	—	10/3	—	—	—	9/3	15/4½	9/3
29..	8/1½	8/1½	14/2½	14/5	8/4½	8/4¾	10/-	—	10/3	—	—	—	9/1½	15/4½	9/1½

PRICES OF RAW AND REFINED SUGAR,

with those of the two previous years.

	Tate's Cubes. No. 1.			Tate's Cubes. No. 2.			First Marks German Granulated f. o. b.			Say's Cubes f. o. b.			German & Austrian † Cubes f. o. b.		
	1905.	1904.	1903.	1905.	1904.	1903.	1905.	1904.	1903.	1905.	1904.	1903.	1905.	1904.	1903.
Jan. 6..	24/7½	17/10½	18/-	22/10½	17/4½	17/-	16/7½	10/4½	9/3¾	19/6	12/3	11/9	18/7½	11/10½	11/3
13..	25/7½	17/10½	18/-	24/10½	17/4½	17/-	17/6¾	10/1½	9/5¼	20/-	12/3	11/9	19/6	11/9	11/3
20..	25/10½	17/9	18/-	25/1½	17/3	17/-	17/9¼	9/11¼	9/3¼	20/-	12/3	11/9	19/7½	11/7½	11/3
27..	25/10½	17/9	17/9	25/1½	17/3	16/9	17/9	10/-	9/3	20/3	12/3	11/9	19/6	11/6	11/3
Feb. 3..	25/10½	17/7½	17/9	25/1½	17/-	16/9	17/5¼	9/10½	9/3	20/3	12/3	11/6	19/6	11/3	11/1½
10..	25/7½	17/7½	17/9	24/10½	16/10½	16/9	16/11¼	9/9	9/4½	20/-	12/3	11/6	19/6	11/3	11/-
17..	25/1½	17/7½	17/10½	24/4½	16/10½	16/10½	16/10½	10/-	9/6	20/-	12/3	11/6	19/3	11/4½	11/1½
24..	25/1½	17/9	18/3	24/4½	16/10½	17/1½	17/1½	10/0¾	9/7½	19/6	12/-	11/6	19/3	11/4½	11/4½
March 3..	25/-	17/9	18/3	24/3	16/10½	17/3	16/10½	10/2¼	9/7½	19/6	12/-	11/6	19/3	11/6	11/6
10..	25/-	17/10½	18/3	24/3	16/10½	17/3	16/6	10/3	9/7½	19/-	12/3	11/6	19/3	11/6	11/6
17..	24/9	18/-	18/3	24/-	17/-	17/3	16/4½	10/3¾	9/7½	18/9	11/9	11/6	19/-	11/6	11/6
24..	24/6	18/1½	18/3	23/9	17/1½	17/3	16/1½	10/5¼	9/6	18/9	12/-	11/6	18/7½	11/9	11/6
31..	24/6	18/1½	18/3	23/9	17/1½	17/3	16/3	10/6	9/6	18/9	12/-	11/6	18/6	11/9	11/6
April 7..	24/6	18/3	18/3	23/9	17/3	17/3	16/3	10/5¼	9/6¾	18/9	12/3	11/6	18/6	11/9	11/6
14..	24/6	18/3	18/3	23/9	17/3	17/3	15/10½	10/4½	9/9¾	18/9	12/3	11/6	18/6	11/9	11/6
21..	24/-	18/4½	18/4½	23/3	17/4½	17/3	15/1½	10/6¾	9/10½	18/9	12/3	—	18/6	11/9	11/6
28..	23/6	18/7½	18/4½	22/9	17/7½	17/3	14/9	10/9	9/11¼	18/-	12/6	—	17/6	12/1½	11/6
May 5..	23/3	18/7½	18/4½	22/6	17/7½	17/3	14/3¾	10/9¾	9/9¾	18/-	12/6	12/1½	17/-	12/1½	11/6
12..	22/9	18/10½	18/4½	22/-	17/10½	17/3	13/10½	11/-	9/9¾	17/-	13/3	12/1½	16/6	12/4½	11/4½
19..	22/-	19/1½	18/1½	21/3	18/1½	17/-	13/6¾	11/4½	9/9¾	16/6	13/6	12/1½	16/-	12/7½	11/4½
26..	22/4½	19/3	18/-	21/7½	18/3	17/-	14/-	11/3	9/9	16/6	13/9	12/-	16/1½	12/9	11/4½
June 2..	22/4½	19/3	18/-	21/7½	18/3	17/-	13/11¼	11/0¾	9/7½	16/6	13/9	12/-	16/1½	12/9	11/4½
9..	22/7½	18/10½	18/-	21/10½	17/10½	17/-	14/2¼	11/-	9/6	16/6	13/9	12/-	16/3	12/9	11/4½
16..	22/7½	18/10½	18/-	21/10½	17/10½	17/-	14/0¾	11/1½	9/4½	16/6	13/6	11/10½	16/1½	12/9	11/3
23..	22/4½	18/9	17/10½	21/7½	17/9	16/10½	14/0¾	11/-	9/3	16/3	13/6	11/10½	16/-	12/7½	11/3
30..	21/10½	18/9	17/9	21/7½	17/9	16/9	13/3	11/2¼	9/3	16/3	13/-	11/10½	15/6	12/7½	11/1½
July 7..	21/4½	18/9	17/9	20/7½	17/9	16/9	12/9	11/4½	9/5¼	16/3	13/-	11/10½	15/-	12/10½	11/2¼
14..	21/4½	19/-	17/9	20/7½	18/-	16/9	12/-	11/6	9/6¾	15/9	13/3	11/10½	15/3	13/-	11/4½
21..	21/7½	19/3	17/10½	20/10½	18/3	17/-	12/10½	11/6¾	9/6¾	15/9	13/6	11/10½	15/3	13/1½	11/5¼
28..	21/7½	19/6	18/1½	20/10½	18/7½	17/3	12/10½	11/9¾	9/10½	15/9	13/6	12/-	15/3	13/4½	11/6
Aug. 4..	21/4½	19/7½	18/4½	20/7½	18/10½	17/9	12/7½	12/1½	10/0¾	15/9	13/9	12/9	14/10½	13/7½	11/10½
11..	21/4½	20/-	18/4½	20/7½	19/3	17/9	12/6¾	12/2¼	10/1½	15/-	14/3	12/9	14/10½	14/-	11/10½
18..	21/1½	20/-	18/6	20/4½	19/3	18/-	12/0¾	12/3	10/3¾	15/-	14/3	13/3	14/7½	14/1½	12/3
25..	20/4½	20/-	18/9	19/7½	19/3	18/-	11/8¼	12/4½	10/4½	14/6	14/3	13 3	14/3	14/1½	12/3
Sept. 1..	19/10½	20/1½	18/9	19/1½	19/4½	19/-	11/4½	12/6¾	10/3¾	14/3	14/3	13/3	14/-	14/4½	‡
8..	19/10½	20/4½	18/9	19/1½	19/7½	18/-	11/3	12/6¾	10/3	14/3	14/3	13/3	14/-	14/4½	‡
15..	19/10½	20/4½	18/9	19/1½	19/7½	18/1½	11/1½	12/6	10/3¾	14/3	14/3	13/3	13/6	14/4½	‡
22..	19/10½	20/7½	18/9	19/1½	20/-	18/1½	12/1½	13/3	10/2¼	14/3	14/9	20/10½	13/3	14/10½	‡
29..	19/10½	20/10½	18/9	19/1½	20/3	18/1½	11/9	13/3¾	10/1½	13/9	15/-	20/10½	13/6	15/-	‡
Oct. 6..	19/10½	20/10½	18/9	19/1½	20/3	18/-	11/4½	12/10½	10/1½	13/9	15/-	20/10½	13/6	15/-	12/3
13..	19/10½	20/10½	18/9	19/1½	20/3	18/-	10/10½	12/9	10/1½	13/9	15/-	20/10½	13/6	15/1½	12/4½
20..	19/10½	21/-	18/6	19/1½	20/4½	17/10½	10/3	12/10½	10/2¼	13/9	15/-	20/10½	12/9	15/1½	12/4½
27..	19/4½	21/-	18/3	18/7½	20/4½	17/9	10/2¼	13/-	10/2¼	13/6	15/-	20/10½	12/9	15/1½	12/3
Nov. 3..	19/1½	22/1	18/3	18/4½	21/7½	17/9	9/9¾	14/4½	10/0¾	13/-	16/3	20/10½	12/-	16/6	12/1½
10..	19/1½	23/6	18/3	18/4½	22/9	17/9	9/9¾	15/0¾	10/1½	12/6	17/3	20/10½	12/-	16/10½	12/1½
17..	18/7½	23/10½	18/3	17/10½	23/1½	17/9	9/11¼	15/6	10/1½	12/6	18/-	20/10½	11/9	17/10½	11/10½
24..	18/10½	23/10½	18/3	18/1½	23/1½	17/9	10/4¼	15/6	10/1½	13/-	18/-	20/10½	12/3	17/10½	11/9
Dec. 1..	18/10½	23/10½	18/3	18/1½	23/1½	17/9	10/1½	15/6	10/1½	13/-	18/-	20/10½	12/3	18/-	11/10½
8..	18/10½	24/1½	18/3	18/1½	23/4½	17/9	10/1½	15/11¼	10/1½	12/9	20/-	‡	12/-	18/-	11/9
15..	18/10½	24/1½	18/3	18/1½	23/4½	17/9	10/0¾	15/6	10/3	12/9	20/-	—	12/-	18/-	11/9
22..	18/7½	24/1½	18/3	17/10½	23/4½	17/9	10/-	15/9¾	10/4½	12/9	19/-	—	11/9	18/-	11/10½
29..	18/7½	24/1½	17/10½	17/10½	23/4½	17/4½	9/11¼	16/-	10/6	12/6	19/-	—	11/10½	18/-	11/10½

† Basis average Hansa FKL FMS. ‡ Not quoted.

H. H. Hancock & Co., 39, Mincing Lane, London, E.C.

IMPORTS AND EXPORTS OF SUGAR (UNITED KINGDOM)

To end of December, 1904 and 1905.

IMPORTS.

Raw Sugars.	Quantities.		Values.	
	1904. Cwts.	1905. Cwts.	1904. £	1905. £
Germany	6,293,214	5,858,713	3,112,667	3,124,948
Holland	750,919	204,016	414,123	113,980
Belgium	1,011,096	1,047,584	562,294	554,045
France	487,099	733,887	254,864	383,305
Austria-Hungary	741,055	440,646	345,696	273,737
Java	1,878,419	2,447,381	917,478	1,548,660
Philippine Islands	85,956	9,023	31,165	4,840
Cuba	....	....	....	....
Peru	1,017,837	1,136,541	508,422	720,608
Brazil	84,316	174,168	32,294	80,634
Argentine Republic	....	....	....	....
Mauritius	524,337	173,476	198,838	93,255
British East Indies	78,836	256,180	30,115	143,662
Straits Settlements	132,526	201,250	56,725	106,383
Br. W. Indies, Guiana, &c.	1,045,940	1,202,190	711,608	903,694
Other Countries	552,390	771,536	285,788	512,809
Total Raw Sugars	14,683,940	14,656,591	7,462,077	8,564,560
Refined Sugars.				
Germany	11,072,842	9,829,362	6,800,207	7,367,414
Holland	3,166,038	1,778,222	2,000,601	1,362,059
Belgium	540,548	314,262	331,363	232,155
France	2,637,620	2,445,842	1,554,859	1,674,974
Other Countries	188,455	345,804	102,422	283,623
Total Refined Sugars	17,605,503	14,713,492	10,789,452	10,920,225
Molasses	1,942,195	2,545,130	363,276	504,011
Total Imports	34,231,638	31,915,213	18,614,805	19,988,796

EXPORTS.

British Refined Sugars.	Cwts.	Cwts.	£	£
Sweden	2,532	1,085	1,035	523
Norway	31,374	21,912	18,461	15,783
Denmark	112,121	98,567	60,284	64,968
Holland	70,519	83,374	41,671	61,619
Belgium	11,300	10,438	6,393	6,566
Portugal, Azores, &c.	18,480	17,954	10,481	12,251
Italy	4,311	19,160	2,174	11,179
Other Countries	337,316	394,815	226,883	319,348
	588,453	647,305	367,382	492,237
Foreign & Colonial Sugars.				
Refined and Candy	23,785	23,775	16,945	20,087
Unrefined	100,879	113,522	57,052	73,060
Molasses	2,625	2,909	1,311	926
Total Exports	715,742	787,511	442,690	586,310

UNITED STATES.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1906. Tons.	1905. Tons.
Total Receipts Jan. 1st to 18th	24,216	64,565
Receipts of Refined ,, ,,	100	100
Deliveries ,, ,,	50,801	64,565
Consumption (4 Ports, Exports deducted) since January 1st	57,350	64,900
Importers' Stocks January 17th	31,948	none.
Stocks in Cuba, January 24th	36,000	74,500
Total Stocks, ,,	138,000	84,360
	1905.	1904.
Total Consumption for twelve months	2,632,216	2,767,162

CUBA.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1904 AND 1905.

(Tons of 2,240lbs.)	1904. Tons.	1905. Tons.
Exports	1,090,061	1,044,430
Stocks	682	73,668
	1,090,743	1,118,098
Local Consumption (twelve months)	44,320	45,160
	1,135,063	1,163,258
Stock on 1st January (old crop)	94,835	——
Total Production	1,040,228	1,163,258

Havana, November 30th, 1905.

J. GUMA.—F. MEJER.

UNITED KINGDOM.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION FOR TWELVE MONTHS ENDING DECEMBER 31ST.

SUGAR.	IMPORTS.			EXPORTS (Foreign).		
	1903. Tons.	1904. Tons.	1905. Tons.	1903. Tons.	1904. Tons.	1905. Tons.
Refined	929,436	880,275	735,674	2,168	1,189	1,189
Raw	632,434	734,197	732,829	2,955	5,044	5,676
Molasses	81,526	97,109	127,256	132	131	145
Total	1,643,396	1,711,581	1,595,759	5,255	6,364	7,010

	HOME CONSUMPTION.		
	1903. Tons.	1904. Tons.	1905. Tons.
Refined	878,251	873,190	731,757
Refined (in Bond) in the United Kingdom	87,152	529,804	552,091
Raw	418,519	119,105	101,475
Molasses	79,186	90,409	124,089
Molasses, manufactured (in Bond) in U.K.	13,747	60,778	57,444
Total	1,476,855	1,673,286	1,566,856
Less Exports of British Refined	51,459	29,423	32,365
Total Home Consumption of Sugar	1,425,396	1,643,863	1,534,491

Stocks of Sugar in Europe at uneven dates, Jan. 1st to 20th, compared with previous Years.

In thousands of tons, to the nearest thousand.

Great Britain.	Germany including Hamburg.	France.	Austria.	Holland and Belgium.	Total 1906.
146	1618	876	875	351	3867

	1905.	1904.	1903.	1902.
Totals	2736 ..	3613 ..	3369 ..	3529

Twelve Months' Consumption of Sugar in Europe for Three Years, ending December 31st, in thousands of tons.

(Licht's Circular.)

Great Britain.	Germany.	France.	Austria.	Holland, Belgium, &c.	Total 1905.	Total 1904.	Total 1903.
1608	946	592	481	170	3797	4217	3721

Estimated Crop of Beetroot Sugar on the Continent of Europe for the current Campaign, compared with the actual crop of the three previous Campaigns.

(From Licht's Monthly Circular.)

	1905-1906. Tons.	1904-1905. Tons.	1903-1904. Tons.	1902-1903. Tons.
Germany	2,400,000 ..	1,598,164 ..	1,927,681 ..	1,762,461
Austria	1,451,000 ..	889,373 ..	1,167,959 ..	1,057,692
France	1,075,000 ..	622,422 ..	804,308 ..	833,210
Russia	1,000,000 ..	950,000 ..	1,206,907 ..	1,256,311
Belgium	330,000 ..	176,466 ..	203,446 ..	224,090
Holland	205,000 ..	136,551 ..	123,551 ..	102,411
Other Countries .	410,000 ..	340,000 ..	441,116 ..	325,082
	6,930,000	4,712,976	5,874,968	5,561,257

THE

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☞ The Editor is not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

NOTES AND COMMENTS.

Mr. George Martineau, C.B., and the Brussels Commission.

We learn with regret that Mr. George Martineau, C.B., has resigned his position as Assistant Delegate to the Brussels permanent Commission, and will, therefore, no longer be present at the bi-annual meetings at Brussels. Doubtless he feels the weight of advancing years and considers that, as "the heat and burden of the day" is over, his place could now be filled by a younger man. Whatever be his real reason for retiring, we are sure that most of our readers will agree that he has earned his country's gratitude for all his long and painstaking efforts, both as an official and as a private gentleman, to destroy the iniquitous bounty and cartel systems, and place the world's sugar industry on a sounder and fairer basis.

But though Mr. Martineau's resignation probably implies that he will no longer accept an official post, we are sure that the sugar industry will yet possess, for some good time to come, the aid of his mature advice and of his ready pen; and we would express the hope that he may be spared long enough to see the time when the influence of the bounties is altogether a thing of the past, and the world's sugar industry has settled down to an era of genuine prosperity.

International Commission for Methods of Analysis.

Dr. Herzfeld of Berlin has convened the members of the *International Commission for Uniform Methods of Sugar Analysis* to a Session at Bern, on August 3rd and 4th next. A useful programme has been drawn up which includes the following: Methods of preparing Fehling's standard test solution, and of determining invert sugar, Mr. Watt (Liverpool), Dr. Wiechmann (New York), and M. Strohmer (Vienna): methods for avoiding, in the optical analysis of sucrose, the error due to the precipitate, Dr. Wiechmann (New York): proposals for the establishment of colour standards in the place of Dutch standards as at present used for commercial tests, Dr. Herzfeld (Berlin). Other speakers will be M.M. Saillard (Paris), H. Pellet (Paris), and Fr. Sachs (Brussels).

International Congress of Applied Chemistry.

Besides the above meeting of the International Commission, this year will witness the *VI. International Congress of Applied Chemistry* to meet at Rome, from April 25th to May 3rd, under the distinguished patronage of H.M. the King of Italy. The section comprising the manufacture and chemistry of sugar will yield numerous important papers. Amongst them we should note :

Recent progress in the extraction of beet juices. Dr. H. Claassen, (Dormagen).
Estimation of sucrose in the beet. H. Pellet (Paris).
Losses in sugar factories. H. Pellet (Paris).
Standardization of saccharimetric scales. Fr. Dupont (Paris).
The effect of surroundings on the composition of sacchariferous plants. Dr. H. W. Wiley (Washington).
The contest between cane and beet sugars. S. Stein (Liverpool).
Chemical control of sugar factories. E. Saillard (Paris).
Chemical selection of the sugar cane. Dr. Kobus (Java).

Altogether 37 papers will be read in the sugar section, of which 17 will be in Italian, 11 in French, 6 in German, and 3 in English.

The Attitude of Liberals towards the Brussels Convention.

The *Journal des Fabricants de Sucre* is rightly apprehensive lest the new Liberal Government should deal in no friendly spirit with the Brussels Convention. It points out how Sir Henry Campbell-Bannerman has never been sparing of ironical criticism in the debates on this measure. "It has been abundantly shown," he once declared, "that this convention has caused some loss; but no one has attempted to prove that it has brought to anyone the least profit." Our contemporary remarks that the possession of the reins of government often modifies the tone of political utterances; but every question of principle should be judged from a purely practical point of view.

"Great Britain and her colonies have every reason for persevering in their support of the measure. The denunciation of this convention would be, without doubt, the signal for the re-establishment of Cartels in Germany and Austria. Armed anew with such formidable weapons, these two principal exporters would make every effort to kill all competition and to dominate the sugar market, to the detriment of all producers and consumers in general, and of those in Great Britain in particular. Is this what the Liberals desire? Far from destroying the agreement at Brussels, they would do wisely, in our opinion, to strengthen and enlarge the basis of the measure, and to increase its efficacy by persuading other States to subscribe to it." This, and the suppression or at least reduction of duties and charges which too frequently are imposed on the consumer to the producers' profit—these should henceforth be the objects in view of a really Liberal Government.

We are glad to quote our contemporary's view of the consequences which would follow any tampering with the Brussels Convention; but we fear we cannot at present hold out much hope of the present Government supporting the Convention as wholeheartedly as did their predecessors in office. Nevertheless we believe that, on the principle of "making the best of a bad job," they will accord the necessary support till the five years have run their course. The crux of the matter will arise when the Convention comes up for renewal a couple of years hence. Then its fate will probably tremble in the balance; but much may happen by then to prevent any disastrous policy succeeding.

Litmus as an Indicator.

In Noël Deerr's work "Sugar and the Sugar Cane," on page 143, the author ventured to express the opinion that litmus was a more suitable indicator than phenolphthalein because the latter was not so delicate, a juice giving a distinct alkaline re-action with litmus not showing alkaline with phenolphthalein. In reviewing the volume Professor E. O. von Lippmann took exception to this statement. We note, however, that in a recent number of the *Archief* Geerligs confirms the grounds of Deerr's preference. Was Lippmann's opinion based on experiments with *cane* sugar or only with beet? We should like to know.

The Canadian Preference.

We are glad to know that, for the present at any rate, the Canadian refiners have agreed to renew the arrangements under which the West Indian sugar producers will once more come in for a share of the 33⅓% preference. The refiners have consented to purchase West Indian sugars on their arrival at rates equivalent to those ruling in New York *plus* 10 cents per 100 lbs. for muscovado and 12 cents per

100 lbs. for crystals. This new agreement shall not last longer than July 1st next unless renewed, but it is to be hoped that it will be continued by fresh negotiation. It is only fair that the West Indian producers should benefit from the reduction in tariff accorded by the Canadian Government; but if the refiners are allowed to have the whip hand, they will naturally do their best to pocket as much of this rebate as they can. Doubtless, however, saner counsels have prevailed.

A Revolution in Marine Propulsion.

We had recently the pleasure of inspecting the latest addition to the Cunard fleet of Atlantic liners, the "Carmania." This vessel is unique in several respects; but apart from its great size (20,000 tons gross) and its palatial interior, the one outstanding feature is its propelling machinery, which consists of a set of Parson's turbines in lieu of the usual quadruple expansion reciprocating engines. This is the largest vessel yet fitted with turbines and the first on the Liverpool-New York route; consequently its trial trip was awaited with great interest, not to say anxiety. Its success has, however, exceeded all expectations, and the turbines have shown an efficiency of 16% in excess of that shown by the reciprocating engines of the sister ship "Caronia," herself a wonderfully economical boat. There are three shafts and screws, one H.P. turbine in centre, and two L.P. turbines, one on each side, as well as two astern turbines working on the L.P. shafts. The amount of work involved in constructing these turbines may be gauged from the fact that there are over 1,200,000 blades in these turbines, each of which had to be set by hand and caulked. Each L.P. turbine weighs about 340 tons complete and is 12 ft. in diameter. Besides the benefit of increased efficiency from the turbines, there is an entire absence of all vibration on board, save perhaps on the boat deck and over the screws. Indeed, it was stated that when under weigh no more vibration was to be felt in some of the saloons than was the case when the boat was in dock. This absence of vibration will prove a great boon to passengers, and we anticipate that ere long nobody will go by a steamer of the older pattern when a turbine boat is available. Meanwhile the Cunard Steamship Co. are to be congratulated on their foresight and energy in initiating the construction of huge turbine liners; a little more than five years ago the possibility of producing such vessels would have been considered utterly impracticable, and in any case it has been a daring experiment.

Floods in Java.

The mail to hand from Java brings word of some heavy floods. Some 13 inches of rain fell in 24 hours and inundated the whole country. Railway lines were washed out and all the telegraph and telephone wires were destroyed. It is feared that a great deal of young sugar cane will suffer heavily, though it is still so early in the season that it may eventually recover.

A Greenock Refinery for Sale.

We learn that the Clyde Sugar Refinery, Greenock, which was to have been sold by public auction on January 31st last is still unsold. Another attempt will be made on March 28th to dispose of this property, as an inspection of the advertisement in our present number will show. The starting price has been reduced to £10,000.

Errata.

In the paper, "The Influence of Soda Salts, &c.," by H. C. P. Geerligs in our December number, a double error unfortunately crept in. In the footnotes on pages 578 and 579, the words "has gone low during analysis" should have been rendered "got lost during analysis."

THE TEMPORARY TRIUMPH OF LIBERALISM.

As we briefly mentioned in our last number, the General Election in the United Kingdom, just completed, has resulted in the overwhelming defeat of the one time invincible Unionist Party and the accession of the Liberals to power by a majority the like of which has not been experienced for upwards of 50 years. The New House is composed as follows: Liberals, 379; Nationalists, 83; Labour, 51; Unionists, 157; majority of Ministerialists over Unionists, 356; majority of Liberals over all other parties combined, 88. It will thus be seen that a full Liberal attendance will ensure an ample majority even over an opposition of Unionists, Nationalists and Labour combined, supposing such a combination were probable. Yet hopeless as the Unionist minority may appear on paper, it is capable of much good if efficiently led, and especially if the party close their ranks and remain loyal to their leader. It should be remembered that one of the most powerful Oppositions that ever existed consisted of only four members. These formed the famous "Fourth Party" of the eighties, which was composed of Lord Randolph Churchill, Mr. A. J. Balfour, Sir Henry Wolff and Mr. (*now* Sir John) Gorst; and their wonderful success in precipitating the fall of Mr. Gladstone's powerful Government is a matter of history. At one time it was feared that serious dissensions between Mr. Balfour and Mr. Chamberlain as regards the conduction of the fiscal reform campaign might lead to the break-up of the Unionists now in Opposition. But at the eleventh hour Mr. Balfour has seen fit to clear up all misunderstandings by adopting in principle Mr. Chamberlain's views, so that the latter will be able to give him whole-hearted support in his endeavours to lead His Majesty's Opposition.

At this juncture we cannot do better than touch on the several causes which are alleged to have led to the Unionist overthrow, and consider what value should be attached to the evidence tendered in support thereof. Since the end of January, the chief newspapers on the Unionist side have daily devoted several columns to the publication of letters from defeated candidates or their agents, as well as from those who have come out once more at the top of the poll, in which they severally give their explanations of the turn the elections have taken. An analysis of this mass of correspondence gives one a fairly accurate idea of the trend of public opinion.

The first reason given is one that is generally admitted, and is usually termed "the swing of the pendulum": the last Government outstayed their leave and the public got tired of them, as they always do of every party which holds the reins of power for a long period; the electors desired to "give the other side a chance," even though the other side had placed no formulated policy before the country. The individuals who have been influenced by such considerations are mainly those of no settled convictions, those lacking education (as regards political history and political economy), and finally those who are opposed to both great parties, and try them by turns to see what is to be got out of them.

Next comes the opposition arising from the dissatisfaction felt by sectarian parties against several measures of reform passed by the late Parliament. The Education Act has incensed Nonconformists, who are said to number rather more than half the church-going section of the population; the Licensing Act has been stigmatized as the greatest boon that has ever been conferred on 'the Trade'—as the liquor traffic is somewhat incongruously called,—and has therefore been fiercely denounced by all those interested in temperance or total abstinence; even the Aliens Act (which, though but two months in operation, is proving a boon and a blessing) has contributed its iota to the overthrow of Unionist candidates, especially in those districts where naturalized foreigners "most do congregate." As to the first mentioned, the Education Act, the uninitiated observer might well conclude that its sole object has been to subject the school children of this country to forms of religious teaching which are abhorrent to their parents or guardians. As a matter of fact, the Act was in the main a general reform of our educational system, with the object of enabling the rising generation to obtain a more efficient and more highly technical education than had hitherto been found possible under existing conditions. Comparisons with the educational systems of other countries had shown the British methods to be distinctly deficient. But the praiseworthy attempt of the late Government to remedy this serious defect was lost sight of in the uproar created by the clauses relating to religious teaching. Undoubtedly the aggrieved parties have had some genuine cause of complaint, but so have all minorities who oppose any given reform. But we question whether religious fanaticism and deliberate misrepresentation have ever before been carried to such lengths, seeing that from this political rebellion has arisen the new form of anarchy, somewhat facetiously termed "passive resistance," the *modus operandi* of whose advocates, it is almost unnecessary to point out, is to refuse payment of that portion of their local rates which is supposed to be set apart for educational purposes, and in some extreme cases to go to prison rather than allow themselves to be distrained upon. This they call "suffering for conscience' sake." The dispassionate observer might be pardoned for asking what becomes of the exhortation to "render unto Cæsar" his lawful due?

Thus it comes to pass that a by no means small section of the population are determined to have the Education Act amended, and for this purpose have striven to put the Liberal party into power. But this issue is purely a domestic one, and while it may have contributed very appreciably to the defeat of the Unionists, it cannot by any means be classed as a verdict of the country against the larger principles of Unionism.

Then what about Tariff Reform and its antithesis, so-called 'Free Trade'? What part have they had in influencing the electors? Much every way; and a striking thing is that both parties profess satisfaction as a whole with the verdict of the nation. The Free Traders claim that the country is overwhelmingly in favour of free trade as we have had it for sixty years past, and they are quite indignant that when they have finally nailed up the coffin of "Protection" (as they invariably term tariff reform), the corpse inside continues to show signs of vitality. The tariff reformers on the other hand assert that where the issue has been purely one of free trade *versus* fiscal reform the results have been by no means discouraging. They merely admit that the country is as a whole not yet sufficiently educated in the new views to make it waive aside all other considerations; which is not to be wondered at when it is shown in how rusty and dilapidated a state the Unionist party organization has been allowed to fall. The proof of this is suggested by the results of the Birmingham elections, where the seven seats were retained by the Liberal Unionists with increased majorities mostly over 4000 and averaging 3600. There, under Mr. Chamberlain's magnetic influence, party organization was kept at a high pitch; the electors were given every opportunity to make themselves acquainted with the principles of tariff reform, and when the time came for them to make their choice, they did so with no uncertain voice. But elsewhere ignorance and lack of information have been only too patent; the cry of 'dear food' so assiduously fostered by the Liberals has been only too successful in hoodwinking the working classes in town and country; and the glaring posters reading, *e.g.*, "Vote for Jones and cheap food," have had more weight than the displays of foreign-made goods which stare the passer-by in the face at nearly every shop window, and represent so much labour lost to British working men, as the latter will themselves come to realize ere long.

Considering then the importance of the *Free Trade v. Tariff Reform* issue, we may as well give our readers some idea of the arguments used by the respective partisans in support of their cause. To those who have not been brought up in the atmosphere of Cobdenism, and who have seen the immense industrial growth of Protectionist countries like Germany, the United States, and Canada, it is little short of marvellous how the United Kingdom can have clung for so many years to old shibboleths, which were perfectly relevant in the days of Cobden when England held the lead in all industrial work and was the world's market, but now are manifestly inadequate to ensure permanent retention of our trade. But old notions die hard, and the early successes of free trade, really due to other causes than those Cobden thought of, so confirmed John Bull in his belief in this economic heresy, that it has taken many decades ere the voice of the tariff reformer could get so much as a tolerant hearing. Now at length he has gained so much headway that he has made a deep mark on the recent elections, and, but for the fact that he belongs to the party who are at present unpopular, there is no saying how far he would not have succeeded in carrying the country.

The Liberals are determined to maintain Free Trade by which they necessarily mean 'free imports' (for they are, by this very resolve, powerless to prevent our exports being at the mercy of any foreign tariff). This one-sided benefit at least enables foreign commodities to be dumped down on our shores at a very cheap price, and so far as these consist of raw material and food supplies, it is all to our advantage. But though free trade precludes all taxation of food as imports, it has no compunction about taxing food for revenue purposes, and as a matter of fact tea, coffee, sugar, wines, spirits, and tobacco are all more or less heavily laden with excise duties. The Liberals in short are pledged to maintain the *status quo*, no matter what happens to our industries. Under no conceivable circumstances will they consent to place a duty on any foreign commodities coming into this country, not even if the foreign country were to entirely exclude our exports. They talk about saving our trade by other means; but when it comes to giving particulars of their new panacea they are silent, and one is forced to conclude that they have no really practical alternative to suggest. A reform of our Consular services is much needed, and if carried out (as the Liberals hint will be the case) will be productive of much good; but it would not heal the disease which is sapping the strength of our country's trade and so at the most would only prove a temporary stimulant.

The tariff reformers, on the other hand, look as well to the question of exports. They assert, what nobody can really deny, that the strength of the country lies in its manufactures, which form the medium of labour for the greatest number. Once our manufactures dwindle, the prosperity of the country is threatened, and ability to buy in the cheapest market is no advantage if we have no output of labour to sell in return. Hence production and its export must always form the foundation of our trade. Exports are therefore of as great, if not greater, significance than imports. Now the fiscal reformers claim that Britain's exports have not kept up with the imports nor with the growth of the population. They assert that this is largely owing to the excessive tariffs imposed by foreign countries on our goods; it proves, what is confirmed by other data, that the nation's output of manufactures is practically decreasing, and that therefore the labouring classes who form the greater proportion of the population are bound to suffer from lack of work. The other data are in the main facts and figures showing how stagnant some of our trades are getting, and how many big industries, which given fair play could expand, are now stationary if not actually diminishing, because they have not only to compete in their own country against goods dumped from abroad, but they are moreover shut out of nearly every foreign country by hostile tariffs. The final result must be closed works and more British working men turned out to swell the ranks of the more or less unemployed, who are even now to be numbered by the million.

Tariff reform proposes to remedy this one-sided system by obtaining from Parliament the power to negotiate for the reduction of hostile tariffs by threatening to impose counter tariffs. This is the minimum reform desired. But Mr. Chamberlain would go further and have a small general tariff on foreign manufactured goods, and a system of reciprocity with our Colonies involving a small duty on foreign corn. These are all sensible proposals and worthy of the most careful consideration, but to the confirmed Liberal Free Trader they are anathema. Nevertheless they are more likely to put an end to the present system, wherein huge imports of foreign manufactured goods invade our shores every year and mean so much work lost to native labour, than are all the platitudes put forward about free trade being the best in the best of all possible worlds. The free trader will point triumphantly to the lump sum representing the nation's income, but he does not state in how many pockets it lies. Therein stands the crux of the whole matter. Is the money well distributed, or is it mainly confined to a handful of wealthy men? We have no hesitation in asserting the latter to be the case. The richest men in the north of England are not usually those who employ large units of labour.

They are the "go-betweens," agents, buyers, brokers, &c., who import from abroad and sell at home after pocketing their substantial commissions. These men by importing foreign goods displace so much British labour; in some cases they do not even sell at home, but re-export to another country. Meanwhile they wax fat and their incomes go towards swelling the "nation's wealth," while outside in the streets the labouring men whom they have deprived of work by purchasing abroad are swelling the ranks of the unemployed. This is no really exaggerated picture and as soon as the labour classes realize it, they will take speedy steps to obtain redress. These "go-betweens" have voted at the recent elections for their own personal interests; they were not over-sure whether free trade would continue to suit the labour classes; but they knew well enough and, rightly we admit, that free trade would enable them, for a few years more at any rate, to amass huge profits such as they have made till now, while a tax on imports would ruin them. As for the British manufacturers and their workmen whose goods would continue to be superseded in every market, it was a case of "the d—— take the hindmost." They have been told to find new markets—but one cannot find *a new world*, and as soon as a newly civilized country or colony gets self-government, the first thing it does is to fortify itself with a protective tariff. Lancashire for example is now on a wave of prosperity; ere many years are flown, she will find Japan has superseded her in the great markets of the East, for the Japanese operative will work for 9d. a day. Then when Lancashire spindles will stop running and her operatives will be thrown out of work, her rich merchants will if necessary retire on their snug fortunes, or will instead invest them in industrial ventures abroad where Protection will keep them secure. The fulfilment of this forecast of ours will of course depend on other factors remaining equal, but it is a fair statement of what is to be expected in the end from the system of free trade which for the present at any rate is supported by the majority of British electors.

Such in effect are some of the considerations relating to the question which will be uppermost in men's minds for many years to come. The Government, being pledged to free trade, will have to exercise their ingenuity to solve the problem of employment, and should a big wave of trade depression again sweep over the country, we very much question whether they will be found ready to cope with it. The Unionists on the other hand will have to renew their party organization and set to work to educate the country in the principles of tariff reform. It is to be noted that the Labour members, who for the first time in our history form a respectable party, intend to approach the fiscal question with open minds. We wonder how long it will be ere they realize that free imports (at least of manufactured goods) is not an ideal arrangement for their followers. That they will realise this in time, we cannot doubt, and then the fear will be lest, from being rabidly free trade, they may become correspondingly protectionist and desire to introduce a sort of Dingley Tariff into the United Kingdom. It must not be forgotten that labour is everywhere protectionist: even in England this is the case as regards the rights of workmen, trades unions, etc., and it is a little singular that it has not yet claimed one other great right, the right to make the manufactured goods required by its own countrymen. This omission will however be surely rectified ere many years are past. If the Labour Party now number 51, they may exceed 100 at the next election, for in many cases during the past election the Liberal candidate has won solely owing to the Labour vote being given to him. Next time he may not get it; the working class population may run a candidate of their own, or may vote for the tariff reformer. We need only quote the words of the *Clarion*, the organ of Labour and Socialism, which said, "We intend to smash Liberalism." We believe they will do it, and we consider the present triumph of Liberalism is only temporary, but that it will enable the Unionists to re-furbish their arms, get rid of their weaklings, and produce once more a strong, undivided party which shall wake up, "think Imperially" and help to bind the British Empire by closer bonds than it has yet ever worn. Then we shall hope to attend the obsequies of that defunct institution, misnamed the "Cobden Club."

STOCKS OF SUGAR ON SEPTEMBER 1ST, 1906.

(F. SACHS in *Sucrerie Belge.*)

As in past years we propose to estimate, after our usual methods, the probable extent of the world's stocks of sugar on 1st September next.

First of all we will give the visible stocks on December 1st, 1905, according to O. Licht (in tons of raw):—

	1905.	1904.	1903.
Germany	1,193,684	1,021,953	1,147,750
Hamburg	70,430	46,130	198,795
Austria	721,243	557,451	621,438
France	806,899	773,896	945,598
Belgium	172,748	137,138	211,969
Holland	86,688	67,073	86,204
United Kingdom	130,937	176,888	206,710
United States	213,449	124,842	103,437
Cuba	95,500	682	122,638
In transit	31,000	66,129	93,494
	3,522,578	2,972,182	3,738,033

The quantities of sugar remaining to be produced between December 1st and August 31st are as follows for the five chief countries:—

	1905-06.	1904-05.	1903-04.
Germany	857,498	345,666	548,140
Austria-Hungary	439,646	196,732	289,825
France	238,148	54,838	195,201
Belgium	80,820	14,264	37,985
Holland	41,399	10,266	15,162
	1,657,511	621,766	1,086,313

The production of cane sugar (excluding that of India) is valued by Otto Licht as follows:—

1905-06	5,250,000
1904-05	4,817,000
1903-04	4,593,000

The exports of cane sugar from September 1st to November 30th have been (excluding Cuba):—

	1905.	1904.	1903.
Porto Rico	2,041	7,403	3,080
Trinidad	456	305	686
Barbados	5,589	4,199	8,402
Martinique	217	636	760
Guadeloupe	181	187	519
British Guiana	41,153	47,046	38,591
Brazil	17,616	12,732	19,051
Java	205,791	291,203	321,846
Philippines	7,321	8,836	10,459
Mauritius	60,463	30,456	65,153
Réunion	5,487	8,049	14,654
	346,315	411,052	483,201

Hence from December 1st there would be the following quantities of cane sugar to dispose of.

	1905-06.	1904-05.	1903-04.
Total cane sugar	5,250,000	4,817,000	4,593,000
Do. Exported from 1st Sept. to 30th Nov.	346,315	411,052	483,201
	4,903,685	4,405,948	4,109,799

The totals available from 1st December to 31st August would hence be:—

	1905-06.	1904-05.	1903-04.
Visible stocks, Dec. 1st.	3,522,578	2,972,182	3,738,033
Production of Beet, Dec. 1st to August 31st	1,657,511	621,766	1,086,313
Cane	4,903,685	4,405,948	4,109,799
Total	10,083,774	7,999,896	8,934,145

The quantities of sugar consumed between December 1st and August 31st were in—

1904-05	6,565,483
1903-04	7,419,113

For the consumption between December 1st and August 31st, 1905-06, it is best to take the figures of 1903-04 as those of 1904-05 were affected by the high price of sugar.

	Tons.
Sugar available between December 1st, 1905, and August 31st, 1906	10,083,774
Sugar consumed	7,419,113
Probable stocks on September 1st, 1906	2,664,661

Former stocks have been as follows :—

VISIBLE STOCKS 1ST SEPTEMBER.

1906	2,664,661
1905	1,434,413
1904	1,515,032
1903	2,204,688
1902	2,036,067
1901	911,776
1900	519,910

It will thus be seen that to judge from every probability the stocks of sugar next September will be appreciably higher than those of any preceding year. There are, however, certain considerations which go to diminish the importance of these stocks. Thus, while the price of sugar during the summer will probably remain about the same as that of the summer of 1904, the consumption will nevertheless increase, owing to growth of population and increasing requirements. One can also reckon on a considerable decrease in the exports of Russian sugar. Finally, it is very probable that the reduction in prices in leading to a corresponding decrease in the sums paid for roots will occasion a considerable decrease in the spring sowings. As, moreover, last year's crop was exceptionally abundant in most countries, it is hardly probable that the 1906 crop will be equally great.

But in spite of all these extenuating circumstances, it is just as certain that a very considerable excess of sugar will arise, and a reduction of the European production by 1½ to 2 million tons is needful in order to attain once more a normal situation. Indeed a reduction of more than one million tons would be necessary to merely ensure that next year's stocks be no more than those of this year.

It would, therefore, be a grave mistake to suppose that a moderate reduction in sowings is all that is needed to raise the price of sugar to its normal level and that one can with impunity pay for beets a price which is not in accord with current market prices.

The Hinton Naudet Process which is being tried at the San Jose Estate, near Cardenas, Cuba, is giving such excellent results that its permanent retention seems assured.

BRUSSELS INTERNATIONAL SUGAR COMMISSION.

The Official Report of the Proceedings at the Autumn Session of the Brussels International Sugar Commission held last October has just been issued as a Parliamentary paper. The principal item is the report of Sir Henry Bergne to the Marquess of Lansdowne dated November 23rd. We reproduce it herewith.

The Permanent Commission under the Sugar Bounties Convention met at Brussels for its autumn session on the 23rd October last.

M. Capelle was unanimously re-elected as President for the ensuing year, the most cordial recognition being made of the esteem with which he is regarded by all the members of the Commission.

The annual financial statement was submitted and passed. It will be found as an inclosure to the present despatch, but appears to call for no special comment.

The Commission next proceeded to a further examination of the position of those countries the decision in regard to which had been adjourned from last session for a more complete inquiry.

The fresh information which had been obtained in respect to each country was laid before the Commission, and, after some discussion, it was unanimously decided that the countervailing duties previously fixed by the Commission as applicable to sugars from Bolivia, Guatemala, Honduras, Paraguay, and the Philippine Islands should not be maintained, it being considered that the circumstances in those countries were not such as to give rise to bounties.

In the case of Nicaragua, the Commission decided by a majority vote that a bounty existed, and consequently maintained the rate of countervailing duty previously fixed, viz., 34 fr. 75 c. for raw sugar and 34 fr. 50 c. for refined sugar per 100 kilog.

I voted against this decision, on the ground that, although the surtax in Nicaragua greatly exceeds the figures permitted by the Convention, and the prices of sugar for internal consumption appear to be much higher than those for exportation, no clear evidence had been brought before the Commission to show that these conditions did actually give rise to a bounty.

It will be recollected that His Majesty's Government had appealed against the decisions arrived at by the Commission in October 1904, fixing countervailing duties as applicable to the following countries:—

Bolivia; Greece; Guatemala; Hayti; Honduras; Nicaragua; Paraguay; The Philippine Islands; Portugal; The Portuguese Possessions.

By reference to my despatch of the 15th May last and by what has been already stated in the present despatch, it will be seen that the appeal of His Majesty's Government has been successful in every instance, excepting in the case of Nicaragua, which is the only one of the above-named countries which now stands condemned as giving bounties on sugar. This last case is, however, of small importance, since no Nicaraguan sugar is imported into the United Kingdom and the issue of a Prohibition Order will not, therefore, be required.

The most important matter before the Commission at its recent session was the case of Brazil. The decision in regard to that country had been adjourned from the April session in order that further information might be obtained. The Brazilian Government, recognizing the importance of the matter, had deputed Mr. Wileman, the Director of the Statistical Department in Brazil, to attend at Brussels to assist the Brazilian Minister in placing the case of Brazil before the Commission.

These two gentlemen were therefore admitted to appear before the Commission at one of its sittings. They handed in an elaborate statement, which was read, and the Brazilian Minister then proceeded to answer *viva voce* any questions which were put to him in connection with the Brazilian system.

After the statement and the explanations given had been considered by the Commission, a long discussion ensued, with the eventual result that it was resolved again to adjourn the decision in regard to Brazil until the next session, fixed for the 12th March, 1906, in order that still further information might be sought by the Permanent Bureau on certain points.

The Commission then considered the case of Panama, and decided that it was not necessary to fix any countervailing duties as applicable to the sugars of that country.

The question of the admission of Switzerland to the Convention on special terms was next considered, and it was resolved that the matter must be settled through the diplomatic channel.

This completed the business of the session.

I was accompanied on this occasion by Mr. George Martineau as Assistant Delegate, and as he is now retiring from that position I wish to draw special attention to the valuable services which he has rendered for many years to successive Governments in placing at their disposal his great knowledge and experience.

The Secretaries to the British delegation were Mr. S. P. Cockerell, of the Foreign Office, and Mr. H. Fountain, of the Board of Trade, to whom my best thanks are due for most efficient assistance.

I have, &c.,

(Signed) H. G. BERGNE.

The estimated production of sugar in Russia for the season 1905-06 is 70 million pouds (2,527,000 metric tons).

The Hawaiian Commercial and Sugar Company, which owns the largest sugar cane plantation in the world, is credited with the intention of making the village of Kahului, in Maui, into a large seaport town. A large harbour is to be constructed, and the entire sugar crop of Maui will eventually pass through it. Railway facilities from all parts of the island will be provided.

SIMPLE METHODS OF CHEMICAL CONTROL.

By T. H. P. Heriot, F.C.S.

(Continued from page 84.)

IX.

The Control of the Clarification.

The tempering of juice has been and, in some quarters, is still regarded as an "art" which defies all scientific "theory." It is true that science has not yet furnished us with a cheaper, or more effective, substitute for temper lime, but in explaining *why* temper lime acts in the way it does and in showing the practical man *how* this agent may be utilised to the best advantage, science has done good service in answering practical questions which had previously remained unanswered. In the absence of scientific knowledge, as applied to the sugar industry, the effect of adding lime to the juice could only be partially understood; the practical sugar boiler being more familiar with visible effects than with the real changes taking place in the materials with which he works. But in so far as he learns by experience and cultivates his powers of observation, he is following the scientific method though he may not know it.

The chemist studies this question from an entirely different point of view and by a more direct method. He commences by analysing the juice and then noting the effect of lime on the constituent parts. By analysing different qualities of juice he ascertains the exact nature of the differences between juice extracted from ripe and unripe canes, from fresh and rotten canes, from healthy and diseased canes, &c., and, according to his "chemical diagnosis" of the juice he prescribes a larger or smaller dose of temper lime.

Our object in this chapter is to show how the treatment of the juice in the factory may be improved by studying the subject in the laboratory by means of the following simple experiments.

1. Collect some juice from the mill and pour it upon the filter paper in the arrangement shown in Fig. 13, Chapter IV. The juice will not filter because it contains an impurity called *albumen* which clogs the pores of the paper. This substance is found in the juices of all plants and closely resembles *animal albumen* of which white of an egg is an example.

2. Whisk up the white of an egg and add a small quantity of same to some clear water in a bottle. On shaking the latter, a dilute solution of albumen will be obtained with which Experiment 1 should be repeated.

3. Pour some albumen solution into a test tube and fix this in the test tube holder.* Fill the spirit lamp with strong alcohol and arrange

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* This is an arrangement for holding the tube when it is heated, and consists of a wooden handle and two brass springs which can be drawn together by a sliding ring. The curved ends of the springs grip the upper part of the test tube.

the wick to give a small flame. Allow the latter to play upon the bottom of the tube and gently shake the latter occasionally. The heated solution rapidly turns milky because albumen is rendered insoluble by heat. In a hard-boiled egg the action of heat is still more striking. The milky appearance in the test tube disappears on boiling the liquid because the albumen separates into small solid particles which are suspended in pure water. The liquid which filtered very slowly, if at all, before heating, can now be filtered with the greatest ease; the whole of the albumen being left on the filter paper whilst pure water drips into the receiver.

4. Heat a little raw juice in the same manner, and after it has boiled, withdraw the tube from the flame and examine the liquid in a good light. Flocculent particles of *vegetable albumen* will be seen descending towards the bottom of the tube, but no amount of boiling will render the juice clear. There are other impurities present which heat alone will not remove.

5. Pour the heated juice upon a fresh filter paper. It filters through very slowly, and the filtered juice is anything but clear.

6. Dip a slip of blue litmus paper into the raw and the boiled juice; it is reddened in both cases. The red colour will be more intense if juice from sour canes is tested. Litmus is a vegetable blue which is turned red by acids; hence, in Experiment 4, we have failed to separate the acids which are always present in cane juice.

A later experiment will prove that when a solution of sugar, containing an acid, is heated, a part or the whole of the sugar is converted into an uncrystallizable form; in other words, that the sucrose is destroyed and new substances produced therefrom. The addition of an alkali to the juice prevents this change, because alkalies combine with acids to form salts which are neither acid nor alkaline. Table salts can be produced by adding a strong alkali—caustic soda to a strong acid—muratic acid. The properties of the two substances mixed entirely disappear, and a new substance is formed with properties differing entirely from the former. This is a case of chemical change as distinct from blending or mere mixing. Alkalies restore the blue colour to litmus which has been reddened by an acid, and advantage is taken of this fact in testing for alkalies. Red litmus papers are, therefore, made by steeping paper in an *acid* solution of litmus; these are turned blue by alkalies and are of no use in testing for acids. On the other hand, blue litmus paper is turned red by acids but is unaffected by alkalies. What is sold as neutral litmus paper is neither blue nor red, but a faint violet colour; it therefore serves to detect either acids or alkalies, and is much more sensitive than the blue and red papers.

7. Shake up a small quantity of milk of lime with some rain-water in a large bottle. The bulk of the lime remains insoluble but a small quantity dissolves in the water and this lime water can be decanted

off clear after a few hours. Dip a red litmus paper into the clear lime water—it is turned blue. Apply the same test to some milk of lime—the blue colour is much stronger. A small quantity of milk of lime is sufficient to neutralize a very large quantity of juice; but, on an experimental scale, we require to add very small quantities of lime, hence lime water is preferable in the following experiments.

8. To a few ounces of raw juice add a small quantity of clear lime-water, mix thoroughly, and test with blue litmus paper. Repeat these operations until the test paper shows no trace of acid, adding the lime-water cautiously as this point is approached. Now test the mixture with a red paper which will turn blue if too much (alkaline) lime-water has been added and in this case add a little more of the (acid) juice until the red papers show no alkalinity. Test the liquid finally with a neutral paper and add juice or lime-water until the mixture is exactly neutral. The acids in the juice are now rendered harmless, and a small portion is also precipitated. Add equal volumes of this neutral juice to four clean test tubes, supporting the latter in the test tube stand. Note that the *cold* tempered juice does not clarify on standing.

9. Heat one of the tubes until the juice boils, and allow to stand. Clarification is now effected, the impurities separating in the form of a sediment, leaving the juice bright and clear. On transfering the contents of the tube to a filter paper, filtration proceeds very rapidly.

10. The three remaining tubes of neutral juice are now treated as follows:—The first is rendered faintly acid by adding a dozen drops of raw juice. The second is made faintly alkaline by adding a drop or two of lime-water. The third is left neutral. Wipe the outside of each tube perfectly clean and heat each, in turn, until the juice commences to boil, and leave the heated tubes in the stand for ten minutes. Although the proportion of lime to juice is different in each tube (as proved by the test papers) the juice will be equally clear in each case, although the colour of the juice may vary. *To all appearances,* clarification is complete in each tube.

11. Decant off the clear juice from each of the above tubes into clean tubes, add two drops of lime water to each, and again heat to boiling. A second precipitate will be formed in the tube containing acid juice, a smaller precipitate in that containing neutral juice, and no precipitate in the alkaline juice. The conclusion to be drawn is that appearances are deceptive since only one out of the three samples had been properly tempered in the first place.

In conjunction with the influence of heat, lime produces a heavy precipitate consisting of various impurities, some of which were originally dissolved in the juice, whilst others, which were merely in suspension, are carried down mechanically by the former. All these impurities can be completely separated from the juice by subsidence or by filtration.

This visible effect is naturally the most striking, but our study of clarification will not be complete until we have learnt what *invisible* effects are simultaneously produced when raw juice is heated with and without the addition of lime.

Solutions of sugar, even when pure, cannot be continuously heated without an invisible change taking place. This is termed *inversion*, and consists in the conversion of the sugar (sucrose) into another variety (invert sugar) which cannot be crystallized from its solutions. Hence, as regards sugar-making, inversion is the destruction of the raw material of the factory.

Whereas inversion is very gradual in the case of neutral solutions of sugar, it is promoted by the presence of acids, and our next experiment is a very instructive one.

12. Prepare a 10% solution of loaf sugar by following the directions given in Chapter 4, and filter if necessary. Fill the observation tube with the clear solution and read off the percentage of sugar in the polariscope (*see Chapter 7*). The reading should, of course, be about 10, but the exact figure is not important. Empty the observation tube into a 50 c.c. flask, and fill the latter to the lower mark with more of the solution. Now fill the flask to the upper mark with muriatic acid, and empty the flask into a larger one in which the acid and juice can be mixed by shaking. Immerse the body of the flask in boiling water or hot juice for ten minutes, and allow to cool. Heat another 50 c.c. of the solution in the same way, but without adding any acid. When quite cold, examine the two solutions in the *glass* observation tube. The neutral solution will give the same reading in the polariscope as before heating, whereas the acid solution will give a *negative* reading (*i.e.*, to the left of the scale-zero instead of to the right). The 10% of sucrose has wholly disappeared, having been transformed into *invert sugar* (glucose), which turns the polarized ray in a contrary direction to sucrose.

Fortunately, the acids normally present in the juice are not nearly so active in this respect as muriatic acid, and being present in minute quantities, the inversion of sucrose in raw juice takes place very gradually on boiling. By neutralizing this natural acidity, inversion is prevented.

Finally, we may enquire what happens when the juice is overlimed, and thus rendered distinctly alkaline, instead of acid. In the first place, the lime dissolves in the juice, so that any excess of this agent merely contaminates the juice instead of purifying it. Secondly, an excess of lime attacks the glucose or invert sugar, combining with it to form organic lime salts, which are gummy, dark in colour, and cause trouble at a later stage. The colour of the alkaline juices in experiments 10 and 11 is due to this chemical action. Thirdly, on greatly increasing the proportion of lime beyond that required to temper the juice, the lime combines directly with the sucrose to form suchrate of lime, from which the sucrose can only be recovered by special treatment.

Having learnt something about the chemistry of clarification, we are now in a position to repeat in the factory some of the experiments made in the laboratory. The results to be aimed at depend not only on the quality of sugar to be made, but also on the *modus operandi* in each factory. Dealing with the manufacture of grey crystals or "non-chemical" sugars, it will be necessary to assume, in what follows, that the juice is heated nearly to boiling-point by passing through one or more juice-heaters, and that the hot juice is then tempered in open tanks, or clarifiers. This is the most general arrangement, but when others exist it will be necessary to modify some of the instructions which follow.

Tempering for non-chemical Sugar.—The first step towards controlling this work is to regulate the strength of the lime-milk so that equal measures of same shall invariably produce equal effects when added to equal volumes of juice. A cheap Beaumé hydrometer should be employed here, and a density of 15°B. will be found most convenient. The mixing of the slaked lime with water to the required density should be personally supervised instead of being left to careless workmen, as is now too often done. Even when the strength has been properly adjusted, the mixture must be frequently stirred up, otherwise the portions withdrawn for tempering the juice will be of very variable density. The only satisfactory way of doing this is to fix up a mechanical mixer, driven by belting off a suitable shaft; such an arrangement can generally be constructed on the spot at very small cost.

The charge of lime-milk for each clarifier is measured into a bucket by filling a pint can a certain number of times, the number being varied according to the purity of the juice under treatment. The charge added to the first clarifier filled in the morning may be approximately guessed from what was found necessary on the previous day. The contents of the clarifier are then thoroughly mixed by stirring, and a sample removed and poured into a wide-mouth phial.*

Testing.—A neutral litmus paper will show whether the juice is acid or alkaline. In the former case, a few additional pints of lime-milk may be added and mixed into the same tank, whilst the charge for the second tank is increased to the same extent. A sample from this second tank is then poured into a second phial and tested with the neutral limus paper. If the latter is still reddened, a further increase of lime is added to this clarifier, and a new charge prepared for the third. These additional charges are continued so long as the tempered juice reddens the neutral or the blue test papers.

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* A number of quinine phials can be procured from a druggist; each phial should be labelled and numbered to correspond with one clarifier. They are to be placed on a small shelf fitted up in front of a window near the clarifier tanks, so that the appearance of samples taken from the different clarifiers may be compared in a good light.

If, on the other hand, the first or a subsequent sample colours neutral paper blue, the juice has been rendered alkaline by an excess of lime, which will be objectionable in proportion as the blue coloration is marked. A faint blue tint, visible only in a good light, is the point to be aimed at.

But test papers are not very sure guides in this work since the action of the lime is not merely to render the juice neutral or faintly alkaline but to precipitate the impurities, thereby rendering the juice clear and bright. To this end we have collected a bottleful of juice from each clarifier, so that the effects of different doses of lime may be compared side by side. Information is thus gained as to the rapidity with which the precipitated impurities subside and the colour and transparency of the upper layer of clarified juice.

In order to prove whether an additional amount of lime will have any purifying action on the faintly alkaline juice the plan adopted in experiment No. 11 may be followed; namely, adding a little clear lime-water to a small quantity of the clarified juice. If the mixture becomes turbid this proves that in tempering this juice sufficient lime was not added to remove *all* the impurities that can be precipitated by lime. This test is more sensitive if the dilute lime-water be replaced by a stronger solution of lime prepared as follows. Dissolve half a pound of white sugar in a quart of rain-water, transfer the solution to a Winchester quart bottle, add some milk of lime, and shake thoroughly. The lime combines with the sugar (sucrose) to form sucrate of lime and this dissolves in the water. Sufficient milk of lime is added to render the whole milky after it has been shaken up several times. The excess of lime is then allowed to deposit as a sediment and the clear solution decanted off or filtered through a filter paper. A "dropping bottle" filled with the filtered solution, should be kept on the shelf referred to above.

The test is then made as follows. After having adjusted the charge of temper lime so that the juice is neutral or faintly alkaline to test paper, a few drops of the sucrate of lime solution are added to a small quantity of the *clear* juice contained in a test tube. This clear juice may be decanted off from the sample bottle after the impurities have settled to the bottom of same, or the test tube, fixed in the holder, may be plunged into the uppermost layer of clear juice in the clarifier.

If, after adding the sucrate of lime and shaking the tube, the juice remains clear, the correct amount of milk of lime has been added, and this quantity may be adopted in tempering the clarifiers subsequently filled.

If, on the other hand, the juice becomes milky under this test, the proportion of lime to be added to the next clarifier may be slightly increased. The test is then repeated with a sample of this juice and so on, until the right proportion of temper lime is ascertained.

Briefly stated, the correct tempering of the juice is ascertained by three independent tests. First, the juice should be faintly alkaline to litmus paper. Second, the *clear* tempered juice should give little or no precipitate when mixed with a solution of sucrate of lime. And third, the insoluble impurities should be flocculent and settle readily, leaving the juice perfectly clear and not too dark in colour.

Tempering for white and yellow sugars.—In this case the main object in view is to produce a colourless juice by carefully avoiding an excess of lime. The chemical treatment which the juice undergoes is very much more complicated than in the case we have just considered, and as this treatment differs somewhat in every factory, no general method of control is practicable.

(To be continued.)

ON THE ESTIMATION OF SUGAR, DEXTROSE AND LEVULOSE IN CANE SUGAR PRODUCTS.

By Noël Deerr.

The calculation of the proportion of dextrose and levulose in cane sugar products does not form a usual part of the routine, the reducing bodies present being returned as "*glucose.*" The calculation may at times be of interest and in allied analyses, such as those of honey, "golden syrup," or the identification of origin of a molasses, is of considerable importance.

Provided the specific rotations of sugar, dextrose and levulose are known and that the sum total of the reducing sugars is also determined, the problem is capable of easy resolution. The solution was, I believe, first given by Wiechmann* in the form—

$$a\,s + x\,d + y\,l = p$$
$$x + y = b$$

a, x and y being the amounts of sugar, dextrose and levulose, and s, d and l being their specific rotations, p the polariscope indication of the mixed sugars and b the sum total of the reducing sugars. In this scheme the sugar is determined as glucose after inversion.

The problem may also be solved from either of the following equations:—

$$1. \quad a\,s + x\,d + y\,l = p$$
$$x + y = b.$$

s being the sugar found by Clerget's process and the other symbols being as above.

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* *School of Mines Quarterly.* Vol., XIII., No. 3.

$$2. \qquad i\,s + x\,d + y\,l = q$$
$$x + y = b$$

i being the specific rotation of invert sugar and q the polarization of the mixed sugars after inversion.

These schemes should give the same results provided that the specific rotations of the three sugars are known.

With regard to those of dextrose and sugar there is no doubt, and in what follows I have taken these as 66·5 for sugar (Nasini and Vellavecchia*) and as 52·6 for dextrose (Tollens†), so that in putting the rotation of sugar equal to unity, that of dextrose is ·793.

The latest data regarding the rotation of levulose are those due to Hönig & Jesser‡. Their results are expressed by the formulae—

$$[\alpha]^{20}_{\mathrm{D}} = -88{\cdot}13 - {\cdot}2583\,p$$

and $$[\alpha]^{t}_{\mathrm{D}} = 103{\cdot}92 + {\cdot}671t \text{ for } p = 9$$
$$= -107{\cdot}65 + {\cdot}692t \text{ for } p = 23{\cdot}5$$

p being the percentage of levulose in the solution and t the temperature of observation.

A solution of cane sugar 13·024 grams in 100 c.c. will on inversion give a solution containing 6·854 grams of dextrose and of levulose per 100 c.c., which will correspond to a solution in water of percentage strength $p = 6{\cdot}7$.

By extra-polation from the above formulae is calculated the formula—

$$[\alpha]^{t}_{\mathrm{D}} = -103{\cdot}22 + {\cdot}668t, \text{ for } p = 6{\cdot}7$$

From this formula I have calculated the rotation in sugar degrees of a solution of levulose of percentage strength $p = 6{\cdot}7$ for the temperatures 20° C.-30° C.; and combining the results with that of dextrose (20·8 sugar degrees for the same concentration) have obtained the rotation of the invert sugar resulting from the inversion of 13·024 grams sugar per 100 c.c.

From the Clerget formula in the form—

$$S = \frac{P - P'}{142{\cdot}66 - \frac{t}{2}}$$

I have calculated also the rotation of invert sugar and of levulose on the lines indicated above and for the same concentration.

The results are combined in the table below:—

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* *Optical Rotation of Organic Substances*, Landholt, p. 590; † p. 582.

‡ *Optical Rotation of Organic Substances*, Landholt, p. 589.

	Hönig & Jesser.		Clerget formula.	
Temperature.	Levulose.	Invert sugar.	Levulose.	Invert sugar.
20	—35·5	—14·7	—37·1	—16·3
21	—35·2	—14·4	—36·9	—16·1
22	—35·0	—14·2	—36·6	—15·8
23	—34·7	—13·9	—36·4	—15·6
24	—34·5	—13·7	—36·1	—15·3
25	—34·2	—13·4	—35·9	—15·1
26	—34·0	—13·2	—35·6	—14·8
27	—33·7	—12·9	—35·4	—14·6
28	—33·5	—12·7	—35·1	—14·3
29	—33·2	—12·4	—34·9	—14·1
30	—32·9	—12·1	—34·6	—13·8

A very considerable difference in the rotations is found, and this difference is due to the increase in the rotation of levulose in hydrochloric acid solution.

This variation in the rotation of levulose following on the nature of the solvent will affect the validity of the Clerget process in the presence of levulose, for allowing that the Clerget process is exact for solutions of sugar and dextrose, in the presence of levulose the direct reading is taken in aqueous solution or in the presence of basic lead acetate, and the reading after inversion in acid solution when the rotation of the levulose initially present is increased; this will have the effect of tending to make the Clerget process show *too high* a percentage of sugar when applied to cane molasses.

To demonstrate this error I prepared three solutions of sugar, dextrose and levulose.

Twenty c.c. of each were diluted to 100 c.c. and the readings observed. Twenty c.c. of each solution were then mixed, made up to 100 c.c. and the mixed solution analyzed following Clerget's process. The results observed were as under:—

Polarization of the sugar solution	27·7
,, ,, dextrose ,,	8·0
,, ,, levulose ,,	7·9
,, ,, mixed solutions	27·8
Inverted polarization of the mixed solutions	—8·0
Clerget ,, ,, ,,	27·9
Polarization of the mixed solutions in the presence of ·5 c.c. basic lead acetate	28·0

The subject of the validity of Clerget's process as applied to cane molasses has recently been the subject of some controversy. Several papers on the subject have appeared during the past two years in the *Bulletin d'Association des Chimistes.*

Remy proposed that the reading after inversion should be taken in aqueous solution, and modified the Clerget formula to that end, a process objected to by Pellet, who, in his most recent publication, states that any such process is useless as the rotation of levulose is materially modified by the conditions under which it is treated, and that acidification of the solution before inversion is also useless, since the rotation of the levulose after prolonged heating is not modified by the addition of acids. This last effect is one which I have not been able to find; a solution of levulose was divided into two portions; one was allowed to stand till the constant end rotation obtained, the other was kept at a temperature of 85° C. for eight hours and, after cooling, made up to its original volume. The rotations observed were in both cases the same. Lindet in a recent publication prefers to use a scheme identical with that of Wiechmann, determining the sugar as glucose after inversion, and combining the polarization before inversion with this result to calculate the amounts of sugar, dextrose, and levulose.

In general the refuse molasses with which I have had to deal are of the following composition:—sugar 30%, dextrose 12%, levulose 8%; the separation of the reducing bodies into dextrose and levulose was made under the equations given above, and following on what is taken as the rotation of levulose, a typical calculation would make the levulose vary from, say, 8% to 8·5%.

Working with a half normal solution the direct reading in a 20 cm. tube is of the order 15 degrees, and the inverted reading from 6 to 7 degrees. Now in the inverted reading the levulose initially present has a rotation higher than in the direct reading, and assuming that the rotation increases in the proportion calculated from the ratio of the rotation as found by Hönig and Jesser and from the Clerget formula, for the instance in question, the inverted reading will be ·2 degree too high; that is to say, the Clerget process will give results about 1% too high.

In general I have found with the molasses with which I have had to deal, that the direct reading uncorrected either for volume of lead precipitate or for effect of the lead acetate on the levulose initially present, gives results very close to those obtained by the Clerget process when all the sources of error are eliminated. A molasses on analysis gave the following results in half normal solution:—

a. Direct reading, 5 c c. lead acetate sp. gr. 1·267 per 13 on 4 grams of molasses	17·0
b. Direct reading after acidification..	16·3
c. Inverted reading..	6·2
d. Clerget reading combining *b* and *c*	17·5
e. Volume of the lead precipitate	3·3 c.c.

Allowing that the inverted reading is ·2 degree too high and correcting for the volume of the lead precipitate, the actual percentage of sugar is found to be 33·5%.

There remains another method of analysis, which has not, I believe, received the attention it deserves, and that is the method of inversion with invertase, or with yeast, due to O'Sullivan and Thompson.* In this method the material under analysis is kept at a temperature of 55° C.—60° C. for four hours in the presence of ordinary beer yeast. When using this process the ordinary Clerget formula must be modified, as now the reading after inversion is taken in aqueous and not in hydrochloric solution. In some experiments using the bottom yeast locally occurring in the distilleries in Demerara, I found the following results:—

Initial polarization of the sugar solution ..	47·7 ..	47·0
Polarization after inversion (acid)	13·5 ..	13·3
,, ,, ,, (yeast)	13·2 ..	13·0

The calculation of the amount of levulose and dextrose is further complicated by the presence of bodies other than these which act on Fehling's solutions. Mannose has been identified in small quantity by De Bruyn and Van Ekesteyn†, and a molasses wash after fermentation still contains bodies which react with Fehling's solution; in this colony, in fermented wash I have found reducing bodies from small traces to as much as 0·8 gram per 100 c.c. corresponding from a trace to as much as 3·0 on the molasses.

Pellet and Meunier‡ in a study of Egyptian molasses found ·20 % mannose and 2·40 % "glutose." This last term is unfamiliar and I take it is synonymous with the term "gallisin." I believe that there exists doubt if this body is one initially present or if it is formed by the action of yeast on the fermentable sugars present. In this Colony I have noticed that a high percentage of "gallisin" or "glutose" in fermented wash is usually accompanied by an inferior fermentation.

So far as regards the determination of levulose, a special method has recently been indicated by Pinoff,§ in which the levulose is estimated colorimetrically by heating with a solution of ammonium molybdate in acetic acid. Details of this method have not yet been published.

There are about 70,000 men employed on the sugar industry in Porto Rico.

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* *Journal of the Chem. Soc.*, 1891, p. 46.

† *Java Archief*, 1896, p. 224.

‡ Berlin Congress, 1903, *Int. Sugar Journal*, No. 65.

§ *Berichte der Deut. Chem. Gesel.*, 1905, p. 3308.

THE PAST YEAR IN DEMERARA.

The exports of sugar for the period January 1st to December 31st amounted to 112,196 tons, compared with 108,136 tons for the previous year. Of this amount Canada took over 64,000 tons, compared with nearly 48,000 tons in 1904; the exports to the United States fell from 42,000 tons in 1904 to 28,600 tons in 1905. There was but little change in the export to the United Kingdom. A considerable quantity of sugar was shipped to Vancouver, and this place seems to be in the way of becoming a refining centre of some importance, as shipments are now being made there from Mauritius. The exports of rum show but little change, rising from 2,186,004 gallons in 1904 to 2,213,134 in 1905, but the export of molascuit has risen from 7,614 tons to 11,066. This increase in the export of molasses products is due to the inferior quality of the cane during the past year.

The local price of refining crystals, which stood at a maximum of $3·60 per 100 lbs. early in the year, fell to a minimum of $1·70 in November, but recovered to $1·90 at the end of the year.

The season was not favourable for a heavy crop. The first quarter of the year was dry, followed by ample rains in the second quarter, to be again succeeded by a drought in the third period; heavy rains set in during the middle of December, making the prospects for the coming crop favourable.

During the middle of the last year high estimates were formed of the end of the year crop, which, however, failed to come up to expectation, due to the very inferior quality of the juice. Fungus was prevalent generally over the colony, the Essequebo estates suffering most severely, and it is generally stated that the canes which suffered most were those dressed with the heaviest applications of sulphate of ammonia.

At the beginning of 1905, 45 factories were in operation, but during the past year three have ceased working; only one, however, is totally abandoned, the remaining two properties being amalgamated with others.

The acreage now under the cultivation of seedling varieties is estimated as about 18,000 acres, equal to about 25% of the whole cane acreage; and it is certain that those estates, which have extended their seedling cultivation, have this year the largest return. The seedling canes do not possess the same milling properties as the Bourbon nor does their megass afford such good fuel, but whether this is due to decreased fibre content or to some inherent property of the seedling varieties, there are no data to show. The seedlings most in favour are D. 628, D. 145, and D. 109; the Barbados seedlings B. 147, B. 109, and B. 208 not being so highly considered. There has been no extension of the cultivation of the White Transparent. A further plant for the mechanical discharge of canes has been imported, so that now there are three factories using this method, and a very complete plant for the crystallization in motion process has been installed on one estate, but the results obtained have not been made public.

Although there is every reason to suppose that each individual factory is worked with great care, yet the collaboration and comparison of results, so characteristic of the industry in Java and Hawaii, remain to be initiated here, and there can be no doubt that such a scheme would be of great benefit to the sugar industry of this colony.

THE CONSTITUTION OF JAVA CANE SUGAR MOLASSES.

By H. C. Prinsen Geerligs.

Director of the West Java Sugar Experiment Station at Pekalongan (Java).

(Continued from page 95.)

Gummy Matter.

The low percentage of gummy matter in the carbonatation molasses is very characteristic of the thorough chemical and mechanical clarification, occasioned by the large quantity of lime used in that process. In every instance the percentage of gums in those molasses is inferior to the lowest figure for that element in one of the defecating factories, which reduces the stickiness of the juices in carbonatation factories to a large degree. This is clearly shown in practical working by the fact that even syrup of carbonated juice is easily filtered, which is impossible in the case of syrup of defecated juice.

Some parts of the land which last time yielded molasses having a high figure for gums, do so again this time. Majong and Petjangaan, which headed the list last time, are again foremost with 4·41% and 3·97% respectively.

The figures are not so high this year as they were five years ago, though this may be a consequence of meteorological circumstances and will be a subject of further researches.

Previous investigations* proved that gum has the property of making molasses viscous and of hampering the proper separation of the molasses from the sugar crystals. If therefore two molasses of the same constitution only differ in their content of gum, the sample containing most of that element will offer more trouble in curing than the other one.

Its influence is however not very much felt, for the tables do not show that the molasses with the highest percentage of gum are at the same time those with the highest quotient.

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* Archief voor de Java Suikerindustrie, 1903, 3.

ORGANIC NON-SUGAR.

The balance over the figure for dry substance and the sum of saccharose, glucose and ash is entered in the tables under the heading "Organic Non-Sugar." In this figure the amount of gum is included, and the remainder should be divided among organic acids, nitrogenous bodies, caramel and other products of decomposition of saccharose or glucose.

The figure for the organic non-sugar is rather considerable in most cases, and the study of the organic acids in cane sugar molasses is not much more advanced than in 1892. The carbonic acid in the ash is, to a certain degree, a measure for the amount of organic acids, but this does not yield an absolute value so long as we do not know which these acids are and what equivalent weight they possess. In a former paper* I assumed the figure of 65 for the equivalent weight, and as they have the equivalent of 22 in carbonic acid after incineration, we may roughly estimate the percentage of organic acids, combined with the bases in the molasses as 3 times the weight of the carbonic acid in the ash. The figure for the carbonic acid is already once accounted for in the ash, so the figure for caramel, nitrogenous bodies and products of decomposition may be found by subtracting again twice the amount of carbonic acid in the ash from the figure for the organic non-sugar, minus the gum. We see that even then in many instances a rather large balance is left, though we must not forget that all errors and discrepancies of the whole analysis are also included in the figure, the accuracy of which is therefore not entirely above suspicion.

The molasses that served for this examination did not foam as a rule; only a single sample frothed a little after arrival, but the majority kept quiescent in the bottles, and remain so even now, thus showing a great difference to the molasses of 15 years ago, when all of them, without exception, frothed over violently as soon as the cork was extracted.

The question of the real cause of the frothy fermentation of after-products is not yet definitely settled, but it is most probably due to gradual decomposition and breaking-up of products of superheating of saccharose and especially of glucose. The sticky masse-cuite, principally that of after-products, adheres to the hot coils in the vacuum pan, which chars part of the glucose, and thus incites the decomposition, which goes on slowly in the cold and violently when the mass becomes heated. Since the time reduction in the boiling of seconds and thirds, and the improvements in the vacuum pans, which now boil under a much better vacuum and at a lower temperature than formerly, the frothy fermentation, which in bygone years was a common occurrence, has now become a rarity.

Very often managers and chemists of sugar factories presume the existence of some dextro-rotatory body other than saccharose in the juices, and send me samples of their syrup or molasses in order to verify it. This was always the case when less sugar was turned out than was expected, and then a foreign body, which polarizes like sucrose and yet is not sucrose at all, was supposed to have been present in the juice in order to account for the shortage. In all those cases I have always been unable to trace such a body, and neither is it to be found in the molasses analyzed here, inasmuch as it results from the negative rotation of the complex matter accompanying the sucrose in the molasses.

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* *Sugar Cane*, 1893, 402.

If, therefore, such a combination has really been present in the juice, then it is no more to be found in the molasses, and in that case the difference in quotient from juice to molasses must be exceedingly high.

When a deficit in sugar turned out leads to the supposition that a part of the polarization in the raw juice was not occasioned by sucrose, but by some other strongly dextrogyrous, non-saccharine matter, it is advisable to see whether the fall in quotient between that juice and the exhausted molasses is, perhaps, uncommonly large, and if this, as it will generally be, is not the case, we had better leave the idea of some such mysterious element alone, and try to account for the deficit in another way.

SACCHAROSE DISSOLVED IN THE MOLASSES ON 100 PARTS OF WATER.

We can easily calculate from the figures of real saccharose and real dry substance how much sucrose is dissolved in the molasses on 100 parts of water. The meaning of that figure will be evident to our readers. Already I have several times pointed out that in cane sugar molasses the quantity of sucrose dissolved in the water which they contain is less than corresponds with the solubility of pure sucrose in pure water of that temperature. I ascribed this to the formation of hydrated combinations of salts, especially those of organic acids with saccharose, glucose, and caramel. These hydrated combinations withdraw free water from the solution, and, therefore, the remaining quantity of free water cannot dissolve so much sucrose as corresponds with the solubility of that matter in the total water content both free and combined. This supposition is not only fully confirmed by the newer investigations, but also extended and completed in a felicitious manner.

When perusing the tables for the quantity of sucrose dissolved in 100 parts of water in the different samples of molasses, the great diversity of the figures struck me. Together with percentages of 300 and more, I encountered others of 150, or only half so great, and what was very strange, the quotients of these diverging samples were about the same, so that the high solubility did not coincide with a high quotient, nor a low solubility with a low one. It might be that the molasses, having a low solubility figure, had originally possessed a high one, but had attracted moisture after being boiled, and thus did not represent an original mother-lye, but a diluted liquid, having of course the same quotient as before; which explains a lower figure for sucrose on 100 water at a same low quotient of purity.

If that was so, the low solubility was not due to the reason mentioned above, but only to the fact that the molasses had been subsequently diluted with water. At the first glance this looks rather probable, when one compares the figure for that solubility of the molasses of the two lists. The lowest solubilities are to be found in the list of molasses from after-product masse-cuites which stood in the crystallizing tanks for weeks at a stretch, and had every opportunity of attracting moisture from the atmosphere. The highest figures, on the contrary, were recorded in the list of molasses, centrifugalled from the masse-cuites a short time after their striking from the pan, so that no dilution by moisture from the air was possible.

On the other hand, as we mentioned on the first page of this treatise, it is feasible to concentrate the masse-cuites destined for the process of making first sugar and molasses in one operation much more than those of after-products, which crystallize out from a string-proof boiled masse-cuite.

The possibility is therefore not excluded that by prolonged evaporation the hypothetical hydrated combination has lost a part of its constitution water, so that it is not strange that such a combination should contain more sucrose on 100 parts of the water left, than formerly when it still possessed its full and normal water content.

The phenomenon of the great difference in sucrose dissolved in the water of the various molasses, while at the same time their quotients did not vary much, can be ascribed to two diametrically opposite reasons.

The true molasses with its proper percentage of water and sucrose may have become diluted by water, and in that case the percentage of sucrose in the water is lower than required by the constitution of the hydrated combination, or the molasses is evaporated too far and deprived by the high temperature and vacuum in the pan of a part of its constitution water, and then the percentage is too high. The only criterion which can guide us in this question is the knowledge whether these molasses with the low percentage are really saturated or not. Now, if they were really diluted, they would be able to dissolve more sugar, and could not deposit small sugar crystals when kept at rest.

Among the molasses analyzed for these researches I picked out those which, after six months' sojourn in my laboratory, had deposited sugar in crystals, and, as the bottles were stoppered and thus no water had evaporated, could be considered as saturated. The amount of crystals was not considerable, and was not of a kind that the constitution of the molasses could have been perceptibly altered if we had removed them before analysis. The *quantity*, however, is of no moment here, but only the fact that those molasses have indeed deposited crystal, and thus, of course, must have been saturated during analysis.

The other molasses, not containing grain, could either be just saturated or diluted, and because they could not be further investigated, those samples were excluded from the following discussion, and only such samples taken into consideration as, by their containing sugar in crystals, were proved to be saturated, and perhaps even a little over.

They are put together in the following table with their figures for degrees Brix, dry substance, and sucrose on 100 parts of water :—

List No. I.

Number of the factory.	Name of the Factory.	Brix.	Dry substance.	Apparent quotient.	Real quotient.	Saccharose in 100 parts of water.
4	Soerawinangon	86·78	82·18	33·19	37·24	172
6	Bogoh kidoel	86·42	80·98	39·53	42·11	179
7	Kawarassan	87·39	82·48	37·53	44·28	209
8	Kemantran 1904	85·64	77·64	35·56	48·50	168
10	Maron	91·92	85·41	33·83	41·92	244
13	Poerwoasri	86·42	81·15	37·26	46·58	205
15	Seloredjo	88·48	82·96	33·69	43·51	208
16	Sragi	87·26	82·85	26·13	36·16	175
17	Sroenie	89·37	83·94	43·86	50·56	265
18	Tirto	85·36	80·92	31·51	38·94	190
20	Trangkil	90·60	85·10	32·34	42·65	244
21	Winongan	87·38	83·61	29·75	38·64	197

List No. II.

27	Adiwerna	81·94	76·72	36·86	43·80	145
33	Djati	89·18	84·50	39·58	48·02	264
35	Doekoewringin	85·04	78·40	29·29	35·59	130
38	Kabat	85·65	77·64	30·59	42·38	168
41	Ketegan	82·76	78·10	32·14	39·27	140
50	Nieuw Tersana	91·16	85·30	34·48	43·61	253
52	Olean	87·30	78·83	29·10	40·95	152
55	Pakkies	83·50	78·40	29·29	35·59	133
60	Poerwokerto	84·40	80·06	34·60	40·12	161
63	Seboroh	85·30	78·84	32·12	41·62	155
65	Soekodhono	88·74	84·10	36·73	42·12	223
68	Tandjongsari	86·83	81·50	29·02	38·43	170
69	Tangarang	83·10	77·44	34·66	46·22	160
70	Tjepiring	84·92	79·96	30·62	42·52	170
71	Tjiledoek	84·10	77·45	35·91	47·17	162
72	Tjoekir	85·46	79·33	29·84	37·37	144
75	Watoetoelis	84·68	79·50	35·34	45·38	176

Notwithstanding that the molasses were saturated, we notice percentages of 150 on 100 water as well as of over 250, which proves that the low solubility represents a more normal position than the samples where so much sucrose is dissolved in the water. It is evident that, as was stated earlier, the common constitution of the hydrated salt-sugar combination is such that the proportion of water to sucrose is as from 100 : 130 to 100 : 160. When it is inferior, the molasses is probably diluted, while if it is higher than these figures, the presumption is justified that the combination has lost some of its constitution water during the boiling process. It is superfluous to mention here that of course the quoted figures of 130 and 160 are not invariable and that these limits might be exceeded in either direction, as they are only approximate. The different relations of the sucrose and glucose with the salts and the water may vary the share of each of the constituents in such a measure that no fixed values can be put down for every one of them. At any rate a molasses, having a glucose content of 21·74 and a figure for the solubility of 339, must be considered as evaporated far over the point of a normal water content of the combination. This is after all confirmed by the appearance of the molasses in question; it was stiffened into a solid, sticky block.

The particular examination not only confirmed my former hypothesis, but gave it an extension, which it missed before. My opinion was as yet, that, apart from the amount of water present in the already mentioned hydrated combination, another quantity of water existed in the molasses, which was not combined, and therefore could dissolve a portion of free (not combined) sucrose to the full extent of the real solubility of sucrose in water. That portion of the sucrose could not be gained, for the sole reason that in order to keep the sucrose-salt combination in solution, and to allow its being cured off from the crystals, it would always be necessary to retain a little free water in the molasses, which, as it dissolves sucrose, prevents a portion of the free sucrose from becoming turned out in the product.

Now this last investigation showed me that we can safely go on evaporating all the free water, and bringing all the uncombined sucrose to crystallization before the hydrated sucrose-glucose-salt combination becomes so sticky and viscous that it can no longer be removed from the crystals by mechanical means, such as centrifugalling or draining off. On the other hand, the instances of the molasses having a very high figure for Brix, together with a high solubility of sucrose in the water of the molasses, prove that relatively much water may be evaporated from the combination before it gets too stiff to be separated.

It is therefore possible to separate really exhausted molasses, which will on no account part with more sugar, from the crystals, and the analyses show that this is done in practical working, and even that in many factories the evaporation is conducted so far that this exhausted molasses has lost part of its hydration water, and thus has needlessly become too thick and too viscous.

Researches on the viscosity of cane sugar molasses* have taught me that at a similar temperature those molasses are most viscous which possess the largest specific gravity, and that therefore a molasses is the more viscous the more it is concentrated. The present examination proved that in many samples the exhausted molasses, surrounding the sugar crystals in the masse-cuite, has been evaporated too far, by which operation it has become stickier and more difficult to be centrifugalled than was required. By an otherwise laudable endeavour to gain as much sugar as possible from the masse-cuite by concentrating it heavily, this excessive concentration has made the centrifugalling more laborious, without the least advantage as regards the yield, and thus has caused trouble instead of gain.

We see, that in many cases, the masse-cuite becomes evaporated too far, and this explains why the highly concentrated molasses of 90 and more degrees Brix are more viscous indeed, but not lower in purity than those having 85 degrees Brix, or even less. This explains, too, why it is possible to dilute a highly concentrated masse-cuite with a relatively large quantity of water or diluted molasses in the cooling tanks, when it has, on preliminary examination, been found too sticky to become properly centrifugalled, while the quotient of the molasses after dilution is not higher than previous to that operation.

The determination of the exact water amount, which combines the best desaccharification with the largest liquidity of the molasses, is still a point for study at the Experiment Station, and will be settled within a short time.

PROPORTION BETWEEN GLUCOSE AND ASH.

The principal difference between beet and cane sugar molasses consists therein that in the former the solubility of the sucrose in the water of the molasses is higher than corresponds with the solubility of pure sucrose in pure water, whereas in the case of the latter it is lower. We have learnt to consider the glucose as the matter which, by occupying the place of a part of the sucrose in its combination with organic salts, makes that part of the sucrose free, and thus diminishes the total amount of dissolved combined sucrose.

We saw further, that within the limits occurring in practical working, a high quotient between glucose and ash coincides with a low solubility in the just saturated molasses, while on the other hand a low quotient will raise that value. This is, of course, only true for the combinations having their own full water content, and not for molasses, which are evaporated too far or diluted with water. It is therefore no wonder if the figures obtained in these analyses, in which many molasses were diluted, and still more of them evaporated in excess, offer no regularity when we would range them after the quotient between glucose and ash, and after the figure for sucrose dissolved in 100 water.

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* Archief voor de Java Suikerindustrie, 1903, 3.

It will, however, be understood that a juice containing much ash and only a few per cent. glucose will yield a molasses which is already exhausted at a much higher quotient of purity than a juice where a large percentage of glucose is accompanied by only little ash or salts. I often receive molasses sent to me for examination, which cannot be desaccharified to a lower quotient than 40, a figure which does not satisfy the manufacturer, who wants a quotient of 30. One day I analyzed a very tough after-product masse-cuite, having a quotient of 50·2 (apparent). Though it looked as if it contained much gum, this was not so, as its percentage did not exceed 1·0 % and therefore could not explain the toughness. The other figures were :—

Saccharose	46·4	Glucose ÷ Ash	1·41
Glucose..	15·4	Potash	3·70
Ash	10·10		

The quotient between glucose and ash was very unfavourable and the amount of potash was too high, while the carbonic acid in the ash amounted to as much as 2·38 %. In this molasses, much of the saccharose has entered into the well-known combination and the molasses has more resemblance to a beet sugar molasses, in which we know the quotient does not fall below 60.

The high ash content, together with the low amount of glucose, produced a bad crystallization and a high purity of the molasses, and therefore it is clear that such boilings, when they are treated just like the usual ones, cause trouble in the separation of the molasses from the crystals.

This time the molasses originated from juice of canes planted on salt land and thus an exceptional case, but we may perceive in the tables instances where the molasses of a whole period show an unfavourable proportion between glucose and ash and in consequence thereof an elevated purity of the molasses :—

No.	Name.	Proportion.	True quotient of purity.
5.	Asembagoes	1·67 ..	46·17
40.	Karang Soewoeng	1·45 ..	44·54
64.	Sindang laoet	1·66 ..	41·78

Under similar circumstances it will prove impossible to work out the molasses to the final quotient of 30, since already before that figure is attained the limit has been reached, and further evaporation only makes the molasses more tough and difficult to handle, but does not bring along a further crystallization of sugar. For this reason we know many estates where the final quotient of 30 is never obtained, while on other estates it often sinks a little lower. I also noticed the fact that on a similar estate the output of sugar calculated after the quotient of molasses of 30 was really obtained so long as the Black Java cane was crushed, but remained short as soon as the fields of that cane were harvested and the Muntok cane, having the same quotient of the juice, came to the mill.

I have no doubt that the extended analyses of the inorganic constituents of cane juice from the different estates grown under different climatological circumstances, and on different soils, will elucidate also this as yet incomprehensible question.

CONCLUSION.

The constitution of the molasses does not depend on the method of working up the masse-cuite. It makes no difference whether the molasses are derived from after-product masse-cuites boiled string proof and cooled during some weeks in the crystallizing tanks, or from first sugar masse-cuites centrifugalled directly.

In many cases the masse-cuites yielding exhausted molasses have been evaporated too far, and the quality of these would not suffer if less highly concentrated boilings were struck; this would facilitate the mechanical separation of the molasses.

The long weary boiling and cooling of seconds and thirds does not cause loss of sugar by inversion; the occasional very considerable losses observed under this method are exclusively due to mechanical losses, the opportunity for which is, at any rate, very great indeed.

The constitution of the molasses is chiefly governed by the constitution of the syrup, and this again is dependent on the constitution of the raw cane juice and on the method of clarification.

The percentage of inorganic elements in the raw juice, together with its glucose content, is one of the chief factors for the limit below which the molasses cannot be further desaccharified; in so far that a high quotient between glucose and ash coincides with a low quotient of purity, and *vice versa*.

The amount of inorganic constituents, principally potash salts, in the juice is a consequence of the conditions of the soil, the climate, and the labour, and is to a certain extent constant for the cane from any given area.

Generally, a low quotient of purity of the juice of ripe cane accords with a high content of inorganic bodies, chiefly potash salts.

The ratio between the sucrose and the water content of an undiluted cane sugar molasses with its proper water amount is as $130 - 160 \div 100$.

Carbonatation removes gums, phosphates, and silica much more thoroughly than defecation.

The rotation of the matter, which accompanies the sucrose in the molasses and does not become precipitated by sub-acetate of lead, is more or less strongly to the left for molasses from defecation, but fairly inactive for those from carbonatation. The presence of foreign dextrogyrous substances was neither suspected nor confirmed.

MAURITIUS.

The publication of the report of Mr. Gleadow, the Indian Forest expert, to the Government of the Mauritius upon the afforestation of the island, has provoked an outbreak of ill feeling from a local newspaper (which affects to be the mouthpiece of the French creoles), similar to that which followed the appearance, in March of last year, of our article entitled, "Mauritius: a Plea for Social Reform." Mr. Gleadow has been guilty of the heinous offence of having deprecated the employment of creoles in situations connected with the forest department, and of having complained of damage done to the trees by labourers in the service of the planters. This newspaper has raised the old cry of "Mauritius for the Mauritians," forgetful of the facts (1) that the author of the obnoxious report has undoubtedly the right to suggest the mode in which his recommendations should be carried out; (2) that the creoles do not possess the knowledge nor the experience required for the superintendence of the forests; (3) that it was his duty to bring to the notice of the Governor the culpable negligence of the planters in allowing their servants to damage what is left of the old forests.

This bigoted opposition to measures designed only for the benefit of the inhabitants, and this identification of the creoles with abuses which Mr. Gleadow and the Government seek to reform, has not merely convicted them out of their own mouths—convicted them of ignorant and unreasonable hatred to all persons and all measures calculated to benefit both the Indian settlers (who form, by-the-bye, two-thirds of the population) and the creoles themselves—but has once more amply justified our article of March, 1905. If governed according to the ideas peculiar to the newspaper in question and others of the same kidney, as expressed in their articles over and over again, Mauritius would, in twenty years or thereabouts, descend to the level of Haiti. We doubt, however, whether they ever take the trouble to consider the effect of the violent language they are so prone to indulge in, or to foresee where the policy of "Mauritius for the Mauritians" would land them.

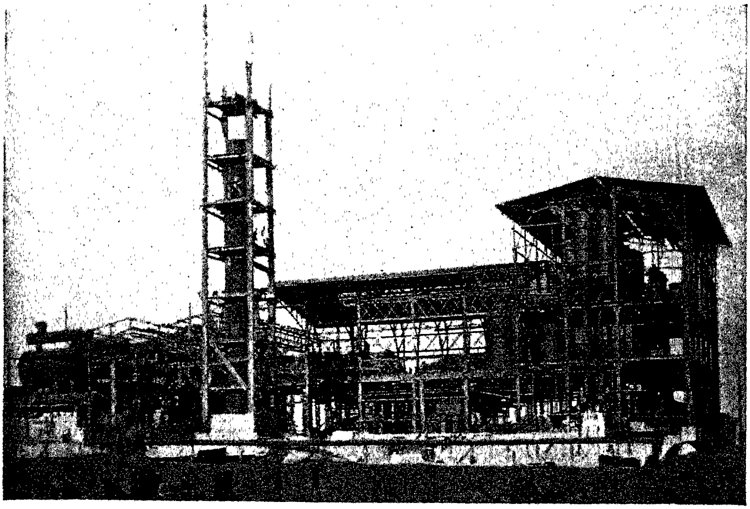
We can only most humbly suggest that journals of this class should no longer identify themselves with the faults of the lower class, but with the virtues of the higher class, and seek to turn their constituents into the path of improvement, refraining in the meantime from vilifying those who, honestly seeking to increase the prosperity of *all* the inhabitants of the island, possess the courage to tell them the truth.

ST. CROIX.

THE LOWER BETHLEHEM SUGAR FACTORY.

We have already had occasion to mention in our Journal the development of the sugar industry in St. Croix, the chief island of the Danish Lesser Antilles and, no doubt, it will be of some interest to our readers to have some details of one of the new sugar factories at work out there.

The Danish sugar manufacturer, Mr. Jacob Lachmann, recently purchased an old factory at Lower Bethlehem. Seeing that the equipment was insufficient and out-of-date, he demolished the whole building and has erected a modern and up-to-date cane sugar factory, with a capacity of 500 tons of cane per day of 24 hours.



LOWER BETHLEHEM SUGAR FACTORY.
EXTERIOR.

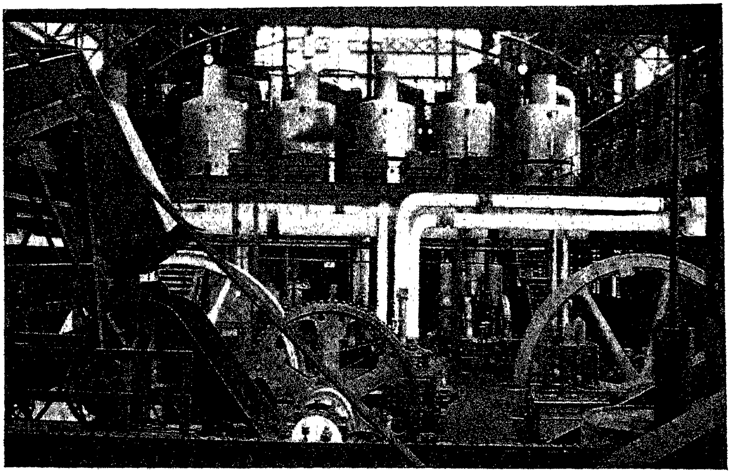
The following is a short description of the new Lower Bethlehem factory:—

All buildings are constructed of iron, on concrete foundations; roofs and walls are lined with corrugated sheet-iron; the roofs have top-lights. Owing to very frequent cyclones on the island, the iron construction of the building has been designed to form a solid and stable structure. The factory is divided into four principal parts:—(1) Mill station; (2) evaporation apparatus; (3) boiling station; and

(4) boiler house, the whole forming a complete and well arranged factory. The sugar store is connected with the factory by means of an iron bridge.

A narrow-gauge railway is provided from the fields to the factory for the transport of cane right up to the carrier in front of the mills.

The sugar produced being the yellow raw sugar of 96° polarization, the installation is designed without scum carbonatation apparatus as used in Java in the most modern and up-to-date cane sugar factories for the production of *granulated;* that is because in this case the only purification employed is sulfitation and double defecation with very complete filtration.



Lower Bethlehem Sugar Factory.
Interior.

A force pump forces the raw juice into three sulphuring vessels and then through a modern, rapid current reheater, where it is reheated to the boiling point. After reheating in such a manner, the juice undergoes the first and the second defecation.

The scums from the defecation pans are mixed and forced through five filter presses. The juice from the second defecation is boiled in a separate boiling apparatus and filtered at once in a series of ten sand-filters of the well-known Breitfeld-Danek's "Perfect" system. The evaporation, working as a quadruple-effet, consists of four vertical vessels.

The juice from the third vessel is sulphurated in two vessels and filtered in six Breitfeld-Danek's "Perfect" sand-filters, then concentrated in the fourth vessel. The different reheaters are heated by means of the exhaust steam from the quadruple-effet. After passing out of the fourth vessel, the syrup is boiled in a vertical vacuum pan of 40 tons capacity to first product masse-cuite, which falls under the vacuum pan into two open refrigerators, from whence the sugar is led into five centrifugals.

The off-running syrups from the centrifugals are saturated with sulphurous acid in two vessels, treated in three "Perfect" sand-filters and boiled in a Karlík-Czapikowski's after-product vacuum "Perfect" crystallizer, of 40 tons capacity, with a rotary heating system.

Under the vacuum pan the masse-cuite is mixed in three open Karlík-Czapikowski's mixers (refrigerators), having a capacity of 36 tons each, with tubular rotary heating and refrigerating system. The second-product sugar is produced in three independent centrifugal machines. The first-product sugar is carried by a grass hopper conveyor and elevator to a sifter and thence in cars to the sugar store.

The after-products sugar is transported to the store by means of a screw conveyor, elevator and cars. The remaining off-running syrups are sold as molasses.

The reheaters are heated by the escaping steam of the Rillieux-Lexa's evaporation system. The barometric central condensation plant is fitted with a double condenser and a dry pump.

All pumps are provided with suitable independent steam-engines. A separate steam-engine is also provided for the main transmission of the centrifugals; this latter engine drives at the same time a rotary water pump, which, in case of scarcity of water, pumps the out-flowing condensed water into a columnar cooler from whence it reverts when cooled into the water cistern and then passes through the main pumping engine into the factory again.

The four combined Meunier steam boilers, 250 sq. metres heating surface and 120 lbs. pressure, are equipped with furnaces for burning exclusively bagasse, which is constantly supplied by means of electrically-driven screw carriers to generators under the steam boilers, wherein hot air is forced by a fan, driven by a separate steam-engine. The superfluous bagasse is carried off in front of the screw carriers and subsequently burnt if necessary.

The boiler-house chimney is of iron, 36 metres high.

The sugar stores are also constructed entirely of iron and are well adapted for storing the sugar in bags.

This modern factory, designed and erected by the Breitfeld-Danek Engineering Company, of Prague, Bohemia, under unfavourable circumstances, as regards the delivery, reveals a very clearly arranged, practical and neat arrangement.

In spite of the entire ironwork (about 830 tons), and the whole mechanical equipment (about 600 tons), having been made in Prague, the entire material was delivered from the manufacturers within 4½ months after the receipt of the order.

The electrical equipment was supplied by Messrs. Kolben & Co., of Prague.

The transport, the erection, and the tests required about 4 months more, so that the Lower Bethlehem's Factory could begin its first crop in about 8½ months after the order was given.

The careful, yet speedy execution of this order by the Breitfeld-Danek Engineering Co., redounds to their credit, and will, we think, prove a record for rapid construction and erection.

RAISING PEDIGREE SUGAR CANES.

The first announcement respecting the possibility of raising seedling sugar canes in the West Indies was made at various times in Barbados between 1859 and 1888. A similar announcement was made in Java in 1887. Since that time seedling varieties have been raised which are capable of resisting the attacks of disease which destroyed the older forms, as well as increasing the yield of sugar. Several experiment plots were maintained in the West Indies from 1888 to 1898, and the success of the results thus obtained must be very gratifying to those who were engaged in the work, for the seedling canes raised by Mr. Bovell and Professor Harrison in Barbados, by Mr. Jenman and Professor Harrison in British Guiana, and by Mr. Hart in Trinidad are now well known in most of the sugar-producing countries of the world.

The earlier method adopted for producing improved seedling canes was by means of a careful selection of casually produced seedlings. The identity of seedlings was derived from the seed-bearing parent only. A further step was raising seedlings from canes planted in alternate rows so that the pollen-bearing parent might be identified as well as the seed-bearing parent. Experiments in this direction were carefully carried on in Java, Barbados, and British Guiana.

By means of a system of rigorous selection both in the field and in the laboratory several good varieties have been raised, but a large percentage of the seedlings produced, as was to be expected, have proved to be worthless. In any case, it took several years before a seedling cane was sufficiently tested under varying conditions to deserve to be recommended to planters, and even then it was left to the planter himself to make a final selection of those which were likely to be suitable for his purposes, as a seedling cane might give very good results in certain soils, or in a wet or dry season, while proving an utter failure in others.

The latter method of attempting to secure cross-fertilization between known varieties referred to above was carried out in Java and elsewhere by carefully selecting two varieties known to arrow at the same time and planting them in adjacent plots. By these means it was hoped that one variety would be crossed by the other. In some cases this no doubt took place. Another step was the bagging of the arrows some time before they reached maturity. On the ripening of the pollen, the contents of one bag were shaken into the bags of another variety, which was to be the female parent. As some of the seedlings were suspected of having been produced by pollination *inter se*, some uncertainty still remained as to the parentage of the resultant seedlings.

An important step in advance was made in the hybridization of the sugar cane, when it was found that certain varieties did not produce fertile pollen, while their pistil was normal; whereas other canes produced a very large amount of normal pollen. Taking advantage of this, the Imperial Department of Agriculture in 1902 started artificial cross-pollination, by means of which the flowers of one variety were emasculated while still young, and then pollen was transferred from one variety by means of a camel's hair brush. Owing to the minute character of the flowers of the sugar cane, this was a difficult process, especially as it had to be carried out while the operator stood on a temporary platform 10 to 12 feet high. This experiment was, however, successfully carried out by Mr. L. Lewton-Brain, B.A., F.L.S. (now Assistant Director of Vegetable Pathology, Hawaiian Sugar Planters' Association), in November, 1904, when he was Mycologist on the staff of the Imperial Department of Agriculture for the West Indies. He worked with some of the best of the Barbados varieties and obtained five seedlings, which proved that the raising of hybrid sugar canes by artificial cross-fertilization was practicable. The resulting seedlings are the first raised in the West Indies whose parentage on both sides is a matter of certainty. They are being carefully propagated, and instructive results are expected to follow. The method adopted by Mr. Lewton-Brain is fully described in the *West Indian Bulletin* (Vol. V., pp. 362-3.).

In view of the success of this work, it was decided last year to make systematic attempts on a larger scale. The work was entrusted to Mr. F. A. Stockdale, B.A., Mycologist on the staff of the Imperial Department of Agriculture. Owing to fluctuating variations in some of the new seedlings, only those which had stood stringent tests on a large scale, for a considerable time, were used in the experiments. That is, an attempt was made to raise pedigree seedlings from selected varieties only. Of these, B. 147 and B. 208 were considered the best, and over 400 spikelets of these two varieties were emasculated and pollinated. Three sound canes were chosen in the varieties to be used, and at least a dozen spikelets in each arrow were operated upon. Crossing was then made in two directions, the pollen parent in one cross being used as the seed parent in the other cross; in other words, one variety was utilized as the female parent in one cross and as the male parent in the other cross.

In all, over 600 spikelets were emasculated and artificially pollinated last year, and it is hoped that the results obtained may be such as will, before long, fully carry out the objects in view. A concise account is being kept of the crosses performed, and next year it is hoped that a series of investigations into the cytology of the sugar cane will be carried on, with the view of determining exactly the right age for pollination, as well as overcoming many of the mechanical difficulties that have hitherto been met with.

If the results of the new method of breeding sugar canes described above are still further extended during the next few years, and the lines so successfully adopted by Messrs. Garton and others in raising new varieties of wheat and oats in England are closely followed, the prospects of the sugar industry in these colonies should be still further improved. There are now no good reasons why we should not be in a position to produce pedigree sugar canes as well as pedigree wheat and oats.—(*Agricultural News.*)

Correspondence.

THE POLARIMETRIC DETERMINATION OF SUCROSE.

To the Editor of "The International Sugar Journal."

Sir,—In your interesting resumé, "Errors in the Polarimetric Determination of Sucrose," the statement given on page 13, lines 19 to 23 inclusive, beginning: "As it is rarely possible to polarize solutions at exactly the same temperature at which they were prepared," etc., is apt to produce an erroneous impression.

This sentence appears in the same paragraph with the recommendations made by the International Commission for Uniform Methods of Sugar Analysis, and, as printed, is apt to give the impression that this International Commission had authorized or sanctioned a temperature correction of ± ·034 per degree C.

As a matter of fact, the Commission refused to accept any calculated temperature corrections even as an alternative method, as you will see from the enclosed copy of its proceedings.

As the matter is one of considerable importance I beg you to publish this correction in your next issue and thank you in advance for your courtesy.

Very truly yours,

F. G. Wiechmann.

Brooklyn, N.Y.,
February 5th, 1906.

[We thank Prof. Wiechmann for drawing attention to this matter. The recommendations of the International Commission for Uniform Methods of Sugar Analysis should have been enclosed in inverted commas, and the sentence commencing "As it is rarely possible, &c." thrown into a separate paragraph.—Editor, *I.S.J.*]

PUBLICATIONS RECEIVED.

"WESTON" CENTRIFUGALS AND ACCESSORIES. Messrs. Watson, Laidlaw & Co., Glasgow. 112 pages 4to with index. A superbly illustrated catalogue of this firm's machinery, comprising centrifugals, masse-cuite receivers, sugar conveyors, trucks, &c.

MONTHLY LIST OF PATENTS.

Communicated by Mr. W. P. THOMPSON, C.E., F.C.S., M.I.M.E., Chartered Patent Agent, 6, Lord Street, Liverpool; and 322, High Holborn, London.

ENGLISH.—APPLICATIONS.

2591. J. HIGGINBOTTOM, Liverpool. *Improvements relating to washing, rinsing, and whizzing wheat, cereals, sugar, granular matter, ores, minerals, and the like.* 2nd February, 1906.

2859. A. AHRBERG, Glasgow. *An arrangement for the preparation of sugar in the form of plates, bars, and the like, in the annular liners of centrifugal machines.* 6th February, 1906.

GERMAN.—ABRIDGMENTS.

162526. LÉON NAUDET, of Paris. *A diffusion process and apparatus in which the juice conducted into the diffuser fed with fresh shreddings is forced by means of a pump to circulate from this diffuser to an intermediate vessel and from the latter back into the same diffuser.* February 21st, 1903. This invention relates to a method of diffusion, in which the juice conveyed into the diffuser, fed with fresh shreddings, is forced, by means of a pump, to circulate from this diffuser to an intermediate vessel, and from this back into the same diffuser, and is characterized by the juice drawn from the forcing diffuser, which is fed with fresh shreddings, being partly conveyed into the next diffuser for mashing the fresh shreddings contained therein, and partly into an intermediate vessel (compensator) and mixed in the ordinary way with the juice contained therein, whilst the juice returned to the first diffuser is withdrawn, by means of a pump, from the intermediate vessel, and forced by the pump through a heating apparatus back to the diffuser, with the object of obtaining, with a constant equalisation of the juice temperature, the speed of operation of the plant, and the density of the juice, an excellent mashing of the fresh shreddings, and preventing any diminution in the speed of circulation of the forced juice. The apparatus employed for carrying out the process hereinbefore set forth, in which apparatus an intermediate vessel is employed, is distinguished by the intermediate vessel being connected with a suction pump, a second pump, and also with a juice-conveying pipe running from the juice pipe of the apparatus, whilst the pressure pipe of the pump communicates with the diffusers.

165795. CARL STEFFEN, of Vienna. *A method of pressing for obtaining pure concentrated beetroot juice and pressed saccharine residues of low water contents.* October 22nd, 1902. (Patent of Addition to Patent No. 149593 of February 15th, 1901.) This invention relates to a method of pressing for obtaining pure concentrated beetroot juice and saccharine compressed residues of low water contents, and is characterized by the fresh shreddings, in order to be suddenly heated to a temperature of from 60—100°, being combined with such large quantities of beetroot juice obtained from the diffusion process and having a temperature of more than 60°, that the total heat existing in the diffusion juice suffices to immediately raise the shreddings to the desired temperature, after which the shreddings are immediately subjected to the pressing operation.

166305. ISABELLA SCHETKE-RAFFAY née HOFLECHNER, of Vienna. *Process for freeing sugar solutions from non-sugar substances.* 22nd January, 1905. In this process a metallic sulphate salt (for instance, copperas) and then a metal (for instance, zinc) is added to the sugar solutions, in the finest subdivision and of such a constitution that it is in a position to precipitate, from the sulphate, the metal as hydrate, developing hydrogen in a nascent condition and combining the freed sulphuric acid, the metallic hydrate forming insoluble compounds with the non-sugar substances, and the hydrogen having a decolorizing action on the sugar solutions in the ordinary manner.

NOTE.—Copies of all published specifications with their drawings in these lists can be obtained from W. P. Thompson & Co., 6, Lord Street, Liverpool, at One Shilling a copy for English or American Patents, and Two Shillings for German. In ordering please give number and date.

Patentees of Inventions connected with the production, manufacture and refining of sugar will find *The International Sugar Journal* the best medium for their advertisements.

The International Sugar Journal has a wide circulation among planters and manufacturers in all sugar-producing countries, as well as among refiners, merchants, commission agents, and brokers, interested in the trade, at home and abroad.

IMPORTS AND EXPORTS OF SUGAR (UNITED KINGDOM)

TO END OF JANUARY, 1905 AND 1906.

IMPORTS.

RAW SUGARS.	QUANTITIES.		VALUES.	
	1905. Cwts.	1906. Cwts.	1905. £	1906. £
Germany	272,939	839,738	196,596	356,859
Holland	46,940	6,765	34,651	2,658
Belgium	134,132	76,677	99,912	31,621
France	1,463	88,827	1,002	38,045
Austria-Hungary	95,050	59,150	69,140	25,835
Java	130,660	89,356	91,263	41,451
Philippine Islands	....	....	....	....
Cuba	....	41,500	....	16,008
Peru	209,961	95,373	159,676	45,156
Brazil	17,559	151,663	12,284	59,012
Argentine Republic	....	....	....	....
Mauritius	25,875	20,861	16,161	8,344
British East Indies	....	....	....	....
Straits Settlements	8,228	5,086	3,701	2,423
Br. W. Indies, Guiana, &c.	157,577	153,864	133,343	89,202
Other Countries	92,708	8,160	69,849	4,110
Total Raw Sugars	1,193,092	1,637,020	887,578	720,724
REFINED SUGARS.				
Germany	1,006,068	921,749	855,495	535,513
Holland	160,563	205,512	139,793	125,292
Belgium	40,277	27,602	34,715	16,559
France	43,691	272,323	37,021	150,037
Other Countries	26,959	72	23,783	90
Total Refined Sugars	1,277,558	1,427,258	1,090,807	825,491
Molasses	119,796	174,990	27,971	38,206
Total Imports	2,590,446	3,239,268	2,006,356	1,584,421

EXPORTS.

BRITISH REFINED SUGARS.	Cwts.	Cwts.	£	£
Sweden	....	111	....	103
Norway	2,647	1,660	2,242	1,021
Denmark	9,152	4,116	7,305	2,127
Holland	6,796	7,880	5,726	4,575
Belgium	444	729	324	415
Portugal, Azores, &c.	1,499	2,978	1,179	1,698
Italy	....	4,858	....	2,616
Other Countries	9,514	51,239	9,191	32,662
	30,052	73,571	25,967	45,217
FOREIGN & COLONIAL SUGARS.				
Refined and Candy	1,682	1,122	1,634	816
Unrefined	3,776	10,329	2,921	5,228
Molasses	163	1,034	70	334
Total Exports	35,673	86,056	30,592	51,595

UNITED STATES.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1906. Tons.	1905. Tons.
Total Receipts Jan. 1st to Feb. 15th	150,905	241,452
Receipts of Refined ,, ,,	100	100
Deliveries ,, ,,	175,408	241,452
Consumption (4 Ports, Exports deducted) since January 1st	171,890	186,250
Importers' Stocks February 14th	34,030	none.
Total Stocks, February 21st	187,000	157,490
Stocks in Cuba, ,,	97,000	181,000
	1905.	1904.
Total Consumption for twelve months	2,632,216	2,767,162

CUBA.

Statement of Exports and Stocks of Sugar, 1905 and 1906.

(Tons of 2,240lbs.)	1905. Tons.	1906. Tons.
Exports	149,888	78,422
Stocks	108,732	59,118
	258,620	137,540
Local Consumption (one month)	4,100	3,960
	262,720	141,500
Stock on 1st January (old crop)	—	19,450
Total Production	262,720	122,050

Havana, January 31st, 1906.

J. Guma.—F. Mejer.

UNITED KINGDOM.

Statement of Imports, Exports, and Consumption for Month ending January 31st.

Sugar.	Imports. 1904. Tons.	1905. Tons.	1906. Tons.	Exports (Foreign). 1904. Tons.	1905. Tons.	1906. Tons.
Refined	59,601	63,878	71,363	78	84	56
Raw	57,569	59,654	81,851	179	189	516
Molasses	7,089	5,989	8,749	1	8	52
Total	124,259	129,521	161,963	258	281	624

	Home Consumption. 1904. Tons.	1905. Tons.	1906. Tons.
Refined	63,400	62,594	66,803
Refined (in Bond) in the United Kingdom	36,837	45,396	47,722
Raw	10,987	8,977	12,872
Molasses	6,118	9,107	9,484
Molasses, manufactured (in Bond) in U.K.	4,967	4,809	5,660
Total	122,309	130,883	142,541
Less Exports of British Refined	2,468	1,502	3,678
Total Home Consumption of Sugar	119,841	129,381	138,863

STOCKS OF SUGAR IN EUROPE AT UNEVEN DATES, FEB. 1ST TO 17TH, COMPARED WITH PREVIOUS YEARS.

IN THOUSANDS OF TONS, TO THE NEAREST THOUSAND.

Great Britain.	Germany including Hamburg.	France.	Austria.	Holland and Belgium.	TOTAL 1906.
157	1634	830	836	325	3782

	1905.		1904.		1903.		1902.
Totals	2568	..	3457	..	3211	..	3369

TWELVE MONTHS' CONSUMPTION OF SUGAR IN EUROPE FOR THREE YEARS, ENDING JANUARY 31ST, IN THOUSANDS OF TONS.

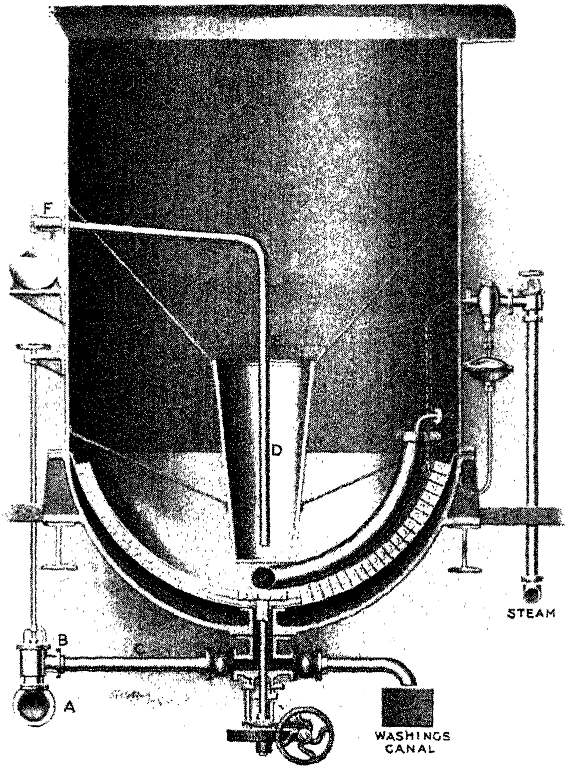
(Licht's Circular.)

Great Britain.	Germany.	France.	Austria.	Holland, Belgium, &c.	Total 1905-06.	Total 1904-05.	Total 1903-04.
1622	949	598	483	165	3819	4206	3782

ESTIMATED CROP OF BEETROOT SUGAR ON THE CONTINENT OF EUROPE FOR THE CURRENT CAMPAIGN, COMPARED WITH THE ACTUAL CROP OF THE THREE PREVIOUS CAMPAIGNS.

(From Licht's Monthly Circular.)

	1905-1906. Tons.	1904-1905. Tons.	1903-1904. Tons.	1902-1903. Tons.
Germany	2,420,000 ..	1,598,164 ..	1,927,681 ..	1,762,461
Austria	1,510,000 ..	889,373 ..	1,167,959 ..	1,057,692
France	1,080,000 ..	622,422 ..	804,308 ..	833,210
Russia	1,000,000 ..	953,626 ..	1,206,907 ..	1,256,311
Belgium	330,000 ..	176,466 ..	209,811 ..	224,090
Holland	205,000 ..	136,551 ..	123,551 ..	102,411
Other Countries .	410,000 ..	332,098 ..	441,116 ..	325,082
	6,955,000	4,708,758	5,881,333	5,561,257



HATTON'S PATENT DEFECATOR.

A Word to Subscribers.

We would draw the attention of our subscribers to the fact that we are too frequently receiving remittances through the Post Office without any separate dispatch note being sent. Post Office Money Orders as a rule *do not contain the name of the remitter;* instead, we are supposed ourselves to supply the name to the Post Office and when we have received no intimation from the subscriber that he has remitted through the Post Office, we are put to much trouble to ascertain who the sender is. A post card intimation would suffice; failing this, however, we cannot guarantee crediting the right person with the remittance. We may say we have lately received a remittance from a Japanese subscriber whose name we have failed to ascertain. Perhaps this gentleman will kindly advise us as to his identity. The above comments apply in particular to remittances from the Continent, India, and Eastern Asia, which are sent us by the Post Office Money Order Department, and not directly by the remitter.

THE
INTERNATIONAL
SUGAR JOURNAL.

No. 88. APRIL, 1906. Vol. VIII.

☞ All communications to be addressed to The Editor, Office of *The Sugar Cane*, Altrincham, near Manchester.

All Advertisements to be sent *direct*.

Cheques and Postal Orders to be made payable to Norman Rodger, Altrincham.

☞ The Editor is not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

NOTES AND COMMENTS.

The Sugar Tax.

The new Chancellor of the Exchequer has not been long in office ere he has had to receive deputations from the sugar users on the subject of the sugar tax. These people have been a thorn in the side of several Chancellors, and the accession to power of the Liberals has been hailed by them as the dawning of a new era. But they received cold comfort from Mr. Asquith. The latter went so far as to agree that, like all taxes, the sugar tax was injurious to the industry affected. But as to taking it off in the existing condition of affairs, that was quite another matter, and the deputation were told that he could not hold out any expectations or hopes of early relief. Taxes have to be raised from somebody, and it is obvious that if these sugar users are relieved, some others will have to bear the burden. The mineral-water manufacturers next had a try, with no better success. They were told they dealt in a cheap but wholesome *luxury*, and as the tax brought in a large revenue, it could not be dispensed with in the present state of finances. Most people will agree that if the nation is to have its drink taxed, this taxation should not be confined to alcoholic consumers, but should also extend to consumers of temperance drinks, in the manufacture of which latter sugar plays no mean part.

Questions in Parliament.

Quite a number of questions on matters relating to sugar have been put in Parliament since it opened last month.

Lord Balcarres (U.) asked Sir Edward Grey whether, if the Government intended to denounce the Brussels Convention at the earliest possible moment, they would give notice of their intention as soon as possible. Sir Edward Grey replied that the earliest date at which they could withdraw was September, 1908, and in that case 12 months' notice was required, so as this notice need not be given before September, 1907, a statement of their policy was not now so pressing and urgent as other matters and they would take their time in coming to a decision.

Mr. Lloyd George, in reply to a question of Mr. Richardson, said there was no intention of making a permanent appointment of an assistant delegate to the Brussels Commission to take the place of Mr. Martineau.

Mr. Harold Cox was told by Sir Edward Grey that the session of the Permanent Commission had been postponed for two months pending the receipt of further information by the Permanent Bureau and His Majesty's Government respecting the Brazilian sugar system.

The House of Commons and the Brussels Convention.

In spite of the fact that Sir Edward Grey had stated in the Commons but a week or two previously that His Majesty's Government did not propose at this juncture to express any opinion regarding the Brussels Convention, one of his own party persisted in moving a resolution on March 27th, declaring that it was expedient to withdraw from the Brussels Convention. This resolution was supported by what the *Times* fittingly describes as "those of the narrowest and most short-sighted school of free import theorists." Mr. Lloyd-George, the new President of the Board of Trade, took part in the debate, and, no doubt forgetting for the moment that he was a Cabinet Minister, gave expression to some amazing statements, amongst which we may quote the one that, previous to the Convention sugar prices were *very steady!* He was followed by Mr. Chamberlain, who in a spirited speech charged the former with giving unfair statistics. He questioned whether the Government really regarded the Convention with as unfriendly an eye as the debate suggested. He thought the Convention was, if no more, a measure of justice to our sugar-producing colonies. The Premier, after taunting Mr. Chamberlain with the responsibility for this measure, showed that he held pretty much the same opinion regarding it as when it was passed into law, but nevertheless he requested that the resolution might be withdrawn, as it was inexpedient for the Government to prematurely denounce the Convention, and thereby hamper its delegate at the Brussels Commission. The resolution was accordingly withdrawn.

British Beet Growing.

It is announced that the Earl of Denbigh has the following on the notice paper of the House of Lords for Monday, April 2nd:—

> The Earl of Denbigh.—To call attention to the success which has attended the experimental cultivation of sugar beet in various parts of Great Britain and Ireland, and to the great advantages which would accrue from the successful establishment of a home sugar industry; and to ask His Majesty's Government whether they intend, in the event of sugar being manufactured in the United Kingdom, to take powers to impose an excise duty on such sugar, and in that case whether they would, in order to encourage the introduction of capital to establish a sugar industry, grant, for a term of years, a rebate of such excise duty, up to the limit permitted by the Brussels Convention to all sugar producing countries.

We trust the ensuing debate will not be barren of results.

The Australian Sugar Bounty Act, 1905.

This act, which was assented to last December, provides that, after January 1st, 1907, there shall be paid out of the Consolidated Revenue Fund to every grower of white-grown cane or beet within the Commonwealth, a bounty on all such cane or beet delivered for manufacture after that date and before 1st January, 1913, at the following rates:—

Sugar Cane.—6s. per ton calculated on cane giving 10 per cent. of sugar, to be increased or decreased proportionately according to any variation from this standard.

Beet.—60s. per ton on the actual sugar-giving contents of the beet.

It is further provided, however, that the rates payable on all such cane or beet delivered during the years 1911 and 1912 shall be respectively two-thirds and one-third of the aforesaid rates.

It is also provided in the Act that "every grower of white-grown sugar who claims the bounty payable under this Act shall, in making such claim, certify to the Minister the rate of wages paid to any labour employed by him, other than the labour of members of his family. If the Minister finds that such rate of wages is below the standard rate paid in the district in which the sugar is grown, to similar white labour engaged in that industry, then the Minister may withhold the whole or any part of the bounty payable."

The employment of any aboriginal native of Australia in the growing of sugar cane or beet is not to prejudice any claim to bounty that may be made. Special permission may also be granted for the employment of white half-castes on the white plantations.

United States Tariff on Philippine Sugar.

An attempt is being made in the United States Congress to pass a Bill providing for the admittance of sugars from the Philippines at a duty of 25% of the full duty rates on sugars coming from foreign countries until April 11th, 1909, after which such sugars are to be admitted free. This Bill passed the House of Representatives in January and was then sent to the Senate and referred there to a Committee. The latter, however, have failed either to recommend the Bill favourably or report it adversely. As a consequence of this, the final outcome of the matter is doubtful. Elsewhere we have commented at length on some aspects of the evidence given before this Committee.

Naturally the United States home beet and cane industries are up in arms against any favouring of this new American territory; and their press organs are disposed to take a very pessimistic view of the matter. Thus a writer in the *Louisiana Planter* discusses at length the ruinous results which the free admission of Philippine sugar would produce. He points out that the total yearly consumption of sugar in the United States is about 2,800,000 tons. The Philippines have more than double the area of Java, which can produce about 1,000,000 tons per annum, and farm and factory labour costs them only one-fifth as much as in the United States, while the cost of ocean freight is no more than rail freights within the States. Consequently Philippine sugar could be delivered in the States at a very much lower cost than it could be produced there and naturally sugar production will become a highly lucrative business in these islands. Immense plantations will be established by American capitalists and the home industries will be seriously threatened. The above writer goes so far as to declare that the admission of Philippine sugar duty-free will sound the death knell of the beet and cane sugar industries in the States. Three classes only would benefit by the proposed tariff reduction: the present large Spanish plantation owners; the speculator who will buy low priced government lands and exploit them with railroads that he can build with government credit; and the monopolists who will establish new sugar plantations. The principal sufferers would be the United States farmers.

Sugar and Rum at Hong Kong.

Hong Kong is the centre of an important sugar industry although no sugar is actually produced there. One portion of the trade is in the hands of natives who import brown sugar and re-ship it for consumption in China and Japan. There is, moreover, an important sugar refining industry conducted by two companies, the China Sugar Refining Co., Ltd., and the Taikoo Sugar Refining Co., Ltd. The first mentioned company also possesses a distillery. The present annual output of the two refineries, when working at full power, is estimated at 250,000 tons.

The International Congress of Applied Chemistry at Rome.

Further particulars of the arrangements in connexion with this Congress have been received. A British Committee has been formed, composed of delegates from the following Societies:—The Royal Society, Chemical Society, Society of Chemical Industry, Society of Public Analysts, The Iron and Steel Institute, Society of Arts, and several more. The General Secretary of the Joint Committee is Mr. Charles G. Cresswell, Palace Chambers, 9, Bridge Street, Westminster, S.W. It may be pointed out that visitors to this Congress have also the opportunity of visiting the Milan International Exhibition. The charge for admission to the Congress is 20 fr., which sum should be remitted to the General Secretary, whereupon a card of membership will be sent to the applicant, as well as coupons to obtain large reductions in the cost of travelling on the Italian railways from April 25th to June 11th. Rooms can be secured in Rome on application to Messrs. Cook & Son. In addition to the business of the Congress, two specially-conducted excursions will be run—one to Sicily to see the mines there, the other to the Isle of Elba.

Messrs. Crosfields Ld.

We regret to learn that the well-known sugar refining firm of Messrs. Crosfields Ld., Liverpool, have got into serious difficulties, as a consequence of which the trustees of the debenture holders have appointed a liquidator in view of a proposed re-construction of the Company. According to the *Liverpool Journal of Commerce* the losses are understood to exceed £100,000, and are accounted for by the extensive continental sugar market rigging of last year, which struck a severe blow at the refining trade. But we sincerely hope the Company will be able to tide over its latest reverse, and that its business will meet with no more than a temporary interruption. There is said to be some hope of the ordinary shareholders securing some return, and with an improved outlook re-construction may be satisfactorily undertaken.

Errata.

On page 143, seventh line from bottom, 70 million pouds is given as equivalent to 2,527,000 metric tons. It should be 1,146,600 metric tons, or 1,125,000 long tons.

THE UNITED STATES AND THE PHILIPPINES.

The Bill for increasing the preference to sugar from the Philippines in the United States market from 25 to 75 per cent. of the full tariff rate is making slow progress and appears likely to be defeated in the Senate.

Some of the evidence given before the Senate Committee is worth noting; though its colour may be somewhat artificially laid on in accordance with the various interests represented. Home-grown cane and beet are of course bitterly opposed to any increase of preferences outside their own charmed circle. The evidence of their witnesses must therefore be received with caution. Still there are a few plums worth picking out and examining.

We have always contended that this system of preferences must eventually break down and vanish by the operation of their own influences. The tariff rate of duty is equal to about 8s. 6d. per cwt. of pure sugar. This is the amount of preference—*i.e.*, extra profit—enjoyed by home-grown cane and beet sugar, and by sugar from Porto Rico and Hawaii. Such an enormous profit must of course stimulate production to the uttermost. The Cuban preference is only one-fifth of this, and yet even this small extra profit promises to bring all available land into sugar cultivation with great rapidity. When all these countries produce enough sugar for the consumption of the United States their preferences automatically vanish and they revert to the natural position of competing with the rest of the world on equal terms.

One of the witnesses declares that this time is close at hand. During the present year, he says, the United States will only have to import about 100,000 tons of sugar paying the full duty; and in 1907 the supply of sugar from Cuba, Porto Rico, Hawaii and the Philippine Islands, together with the domestic supply of beet and cane sugar will equal the consumption. If so, the favoured States, territories and countries have but a short time left in which to enjoy their big profits. Some of them will find great difficulty in competing under natural conditions; others will flourish under any circumstances.

The Philippines are joining in the feast too late to make much out of it. And unfortunately their industry is still in its antiquated state. If we are to credit this same witness the mode of production is most primitive. The plough is a crooked stick with an iron point at one end and turns up only about 3 inches of soil. Therefore they have to go over the land four or five times to make any impression. The mill for crushing the cane has rollers about 10 inches in diameter and 18 inches long and takes only two or three stalks at a time. The juice runs into a pit, from which it is ladled up into pails and carried to the half-dozen kettles set over a fire in a trench in the ground.

The thick pasty mass of boiled juice is shovelled out of the kettles into pear-shaped earthen jars where it drains off leaving a dark-brown sugar, well known to our sugar refiners in years gone by. It appears from the evidence that 60 per cent. is the outside estimate of the proportion of juice extracted from the cane, and we know that the resulting sugar contains not much more than 50 per cent. of extractible pure sugar. These primitive sugar planters are said to obtain 1¼ tons of this crude sugar per acre.

Good soil, favourable climate and cheap labour are there and only require exploiting. It remains to be seen whether American capital will step in and show the Filipinos how to make sugar. The islands have in former days occupied a leading position among the sugar-producing countries of the world; that is, in the days when 200,000 tons were regarded as a large amount for any one country to produce. The following table, compiled by Messrs. Willett and Gray, the New York sugar statisticians, and put in by Mr. W. P. Willett in the course of his evidence, gives an interesting little history of the rise and decline of the industry and the distribution of its products during half a century. For more than 25 years Great Britain was its best customer.

Quantity of Raw Sugar Exported from Philippine Islands to various Countries from 1849 to 1905, in tons of 2,240 pounds.

[Compiled by Willett & Gray.]

Calendar Years.	Great Britain.	Other Europe.	Australia.	United States.		China and East Asia.	Total.
				Atlantic.	Pacific.		
1849	11,545	....	6,094	5,593	....	....	23,232
1850-1854	13,952	....	9,616	8,048	935	....	32,551
1855-1859	21,369	....	14,040	6,967	1,903	....	44,279
1860	27,231	....	10,976	13,204	4,342	....	55,753
1861	26,666	....	18,550	4,885	2,626	....	52,727
1862	37,603	1,162	28,413	6,482	4,160	2,922	80,742
1863	26,886	819	15,424	3,422	4,786	23,672	75,009
1864	41,854	429	1,794	6,346	9,043	4,319	63,785
1865	20,292	939	11,543	4,290	8,202	9,910	55,176
1866	29,417	685	3,607	5,365	8,234	7,528	54,836
1867	31,715	1,788	7,617	6,156	5,111	12,172	64,559
1868	51,216	660	6,061	11,601	2,753	1,789	74,080
1869	32,055	437	7,202	21,497	7,546	90	68,827
1870	40,547	2,307	7,156	19,039	4,100	5,063	78,212
1871	34,744	3,592	8,737	34,121	6,240	31	87,465

Quantity of Raw Sugar Exported from Philippine Islands to various Countries from 1849 to 1905, in tons of 2,240 pounds—Continued.

Calendar Years.	Great Britain.	Other Europe.	Australia.	United States.		China and East Asia.	Total.
				Atlantic.	Pacific.		
1872	52,773	2,766	7,277	24,418	7,801	491	95,526
1873	35,266	4,468	13,649	27,412	8,409	134	89,338
1874	41,637	2,545	7,924	37,038	14,178	540	103,862
1875	63,074	1,777	7,703	41,693	11,855	87	126,188
1876	49,352	1,549	974	59,467	19,066	22	130,430
1877	55,406	2,528	....	55,138	9,179	160	122,411
1878	46,572	3,133	1,681	47,009	16,892	2,639	117,926
1879	69,151	2,168	....	53,237	2,839	7,409	134,804
1880	69,818	4,490	575	97,908	5,048	2,909	180,748
1881	108,909	9,532	3,120	80,419	4,949	4,488	211,417
1882	66,162	3,162	1,559	75,907	2,081	2,122	150,993
1883	56,309	9,214	....	140,656	8,874	183	215,236
1884	18,721	8,073	....	77,191	12,437	6,503	122,925
1885	33,292	4,175	....	147,997	4,829	22,498	212,791
1886	26,448	5,442	....	130,883	400	19,012	182,185
1887	29,887	4,510	89	118,997	4,500	21,165	159,146
1888	35,155	4,629	86	84,564	34,293	26,529	181,256
1889	52,111	5,122	....	147,534	....	14,158	218,925
1890	40,041	3,426	....	67,511	....	36,143	147,521
1891	52,988	2,333	....	92,392	....	18,697	166,410
1892	86,632	3,032	....	81,321	....	75,156	246,141
1893	101,440	3,343	....	78,771	....	77,983	261,537
1894	60,601	3,993	....	56,884	....	70,931	192,409
1895	85,307	3,778	....	61,961	....	75,122	226,168
1896	48,379	3,304	....	89,464	....	80,628	221,775
1897	49,843	3,778	....	21,409	....	127,048	202,078
1898	42,228	....	....	32,547	....	103,572	178,347

Calendar Years.	Great Britain.	Other Europe.	Japan.	United States.	Hong-kong.	China.	Total.
1899	8,298	....	30,983	22,105	28,224		89,610
1900	13,248	....	14,622	2,100	32,723		62,693
1901	....	....	27,194	5,100	23,461	....	55,755
1902	6,213	....	16,400	2,550	53,017	13,531	91,715
1903	....	....	31,366	33,805	15,844	7,027	88,042
1904	4,350	....	14,666	20,893	28,554	16,402	84,865
1905	8,160	....	4,156	35,270	37,749	15,896	101,231

Mr. Willett gave a good deal of interesting evidence. He was anxious to show that the preferential treatment of Philippine sugar involves a violation of the Brussels Convention and requires application of the penalties attached to such violation. He had addressed a circular letter to various friends in England, Belgium, and Germany, in which he says :—

"The question we would like to have you submit to the Belgian member of the Brussels permanent committee or to some other good authority is as to whether the above concession made by the United States to the Philippine Islands is likely to be considered by that Commission as a violation of the Brussels Convention and requiring the penalties attached to such violation to be established against Phillipine Island sugars coming into the country of the party signatory to the Convention. The clause of the Convention which seems to apply to this matter is the following, under Article I. :—

(c.) Total or partial exemptions from taxation granted for a part of the manufactured output."

This quotation from Article I. has, of course, no bearing on the question ; it refers to quite a different matter, namely, the method by which indirect bounties were obtained in the country of production. The duty was levied on the roots according to an estimated yield, which yield was greatly exceeded in practice. Part of the manufactured output, therefore, enjoyed a "total or partial exemption from taxation." The sugar when exported received the full drawback and, therefore, obtained a larger return of money than that representing the duty it had really paid. It therefore secured a bounty on export. This has nothing to do with sugar from one country receiving preferential treatment in another country.

A reply to this question was, however, received from "the Society for the Exportation of Sugar" at Antwerp, very heartily supporting Mr. Willett's contention. Exporters of sugar to Great Britain seem to imagine that the exclusion of a few thousand tons of sugar from a country which consumes 1,500,000 tons, and which has 10,000,000 tons to choose from, must be to their advantage. They forget that the price of sugar in Great Britain is the world's price, and that that price is governed by the total production of the world, no matter how that supply may be distributed. Nevertheless the Antwerp exporters catch greedily at the suggestion held out to them and reply promptly to Mr. Willett :—"You may assert with safety that any appreciable imports of Cuban or Philippine sugars into U.K. would entail their prohibition."

This correspondence is carefully laid before the Senate Committee, but the witness, though he gives various little extracts from the unpublished minutes of the proceedings of the Brussels Commission, fails to quote from the published Report of the British Delegate—the only published information on the subject so far as we are aware—(Commercial, No. 3, 1905. International Sugar Commission. Spring Session, 1905. Report of British Delegate.), in which the matter is clearly stated and conclusive reasons given against any such view. At page 23 of this Parliamentary Paper the British Delegate deals with the question as follows:—

"The question was raised whether the preference given in the United States constitutes a bounty on Cuban sugars.

"To this the British delegation replied as follows:—

(Translation.)

" '*Sir Henry Bergne* says that it is true that sugar imported from Cuba into the United States of America obtains a preference of 20 per cent. as regards import duties over sugar from other sources. The opinion has been expressed that the privilege thus accorded to Cuban sugar is of the nature of a bounty. This view seems based on the assumption that this preferential treatment secures to Cuban sugar a market which enables Cuba to throw her surplus production on the other markets at inferior prices.

" 'It seems impossible to maintain that preferential treatment granted by a third country must be considered as a bounty. The Convention has in view sugar which receives bounties derived from the action of the Government of the country of origin, and not sugar which enjoys advantages due to the legislation of other countries.

" 'It might, perhaps, be said that the Philippines, and in a certain measure Cuba, enjoy advantages through the action of a State which in some measure plays the part of the mother-country. Nevertheless, the Commission cannot consider that advantages of this kind are equivalent to bounties, seeing that France is at liberty to grant a preference to sugar from her Colonies, who pay only the excise duty of 25 fr., without the surtax (5·50 or 6 fr.) paid by sugar from foreign countries. The Commission has likewise decided to this effect in the case of the Portuguese possessions.' "

This appears sufficiently conclusive. A further point in Sir Henry Bergne's statement, namely, that the amount of preference is less than the permitted preference to the home producer—and, in the case of France, to the colonial producer—of 6 fr. per 100 k., is not necessary to clench the argument; nor would it apply if the preference were raised to 75 per cent.

The British Delegate concludes his report on the subject as follows:—

"I added that the argument that the receipt of preference in another market constitutes a bounty would lead to the conclusion that any Treaty of Commerce which might be concluded between two countries, granting favourable terms as to customs duties on sugar, might be adjudged to create bounties—a proposition which was perfectly inadmissible."

That was a pretty strong argument to put on the top of the others, and the Commission promptly postponed any further consideration of the question.

If the matter should ever come up again the British Delegate has pretty firm ground to stand upon,—a position from which it will be quite impossible to displace him.

It will be interesting to see what the United States Senate will say. They are hardly likely to endorse Mr. Willett's theory.

SIMPLE METHODS OF CHEMICAL CONTROL.

By T. H. P. Heriot, F.C.S.

(Continued from page 150.)

X.

The Control of the Juice.

Since sugar is "made" by the sugar cane, the work of the factory is merely to separate this sugar from other constituents of the plant which have no commercial value. In other words, the "manufacture" of sugar consists in packing the produce of many acres of land into the smallest possible compass.

Every estate owner can tell you how much sugar his factory *exports* but very few can tell you how much sugar is *imported*, and yet he pays for these imports either in hard cash to the cane farmer, or in wages to his own field-labourers. Canes may be purchased by weight, but canes are not sugar, and only the chemist can ascertain what price is being paid for the sugar in the canes. Hence, chemical control is to the sugar producer what book-keeping is to the business man.

And, just as the business man must understand the principles of book-keeping in order to ascertain his financial position from time to time, so the manager of a sugar factory should understand the principles of chemical control in order to run his factory on economic lines by calling in the services of the chemist, or by handling the polariscope himself. In the present chapter we shall attempt to explain how the polariscope enables us to take stock of the sugar entering the factory in the form of juice.

Before entering into details, it will be well to take a general view of the task before us.

By means of the polariscope we shall learn what weight of sugar is dissolved in 100 volumes of juice. For the sake of convenience, the result will be expressed in pounds per gallon.

As only an ounce or two of juice can be examined in the polariscope, one main difficulty will be to obtain a sample accurately representing the whole of the juice passing into the factory per day. The total volume of this juice being also measured,* we shall finally obtain the information sought by multiplying the total number of gallons by the pounds of sucrose per gallon as indicated by the polariscope, and hence termed the *Indicated Sugar in the Juice.*

SAMPLING.

A sample caught from the mill bed can only represent the small quantity of juice then flowing. Such a sample is, therefore, mainly useful for testing the juice extracted from a particular lot of canes, as in the experiments described in Chapter VIII.

A general sample is best obtained by mixing together small samples taken from each clarifier tank filled during the day. This is done as follows:—

Referring to the last chapter it will be seen that samples of juice were taken from each clarifier in rotation after the contents of the latter had been tempered and mixed. These samples may therefore be regarded as accurately representing the bulk, so that by mixing together equal volumes of juice taken from every phial (or, indirectly, from every tank) we can obtain a single sample representing the total number of gallons treated per day.

After standing undisturbed for, say, half-an-hour, the clear juice is decanted from each phial (in turn) into a 50-55 cc. measure flask until the latter is filled to the lower mark. The flask is then emptied into one of the large stoppered bottles (to be hereafter referred to as the "sample bottle"). When this has been done, the balance of the juice left in the phials can be emptied out and the phials refilled from their respective tanks. To prevent fermentation of the juice a minute quantity† of bichloride of mercury is dropped into the sample bottle before commencing. (*Note.*—The small bottle containing the bichloride must be kept in the laboratory as it is highly poisonous.)

As it is essential that every tank of juice should be duly represented in the sample bottle, the pan boiler or the factory overseer should be placed in charge of the work which may include the various tests described in the last chapter. As a further check it is of course easy to measure the volume of juice collected in the sample bottle at the end of the day, using the 200 and 100 cc. flasks; this volume divided by 50 should give the number of clarifiers "run."

As it is customary to finish off the day's work by washing down the mill, special care must be taken in sampling the last two or three clarifiers which would contain a mixture of juice and wash-water. It is merely necessary to remember that whatever it is to be evaporated has also to be measured and sampled if our system of stock-taking is to be a practical one.

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*See Chapter I.

† As much as will rest on the tip of the blade of a pocket knife.

ANALYSIS.

A sample of juice collected from the mill bed and measuring, say, a pint, must be allowed to stand for about 20 minutes in order to allow the suspended impurities to settle, and the air bubbles to rise. The foam is then removed as completely as possible by means of a large spoon, and the liquid slowly decanted into a hydrometer jar, placed on the laboratory sink (*Fig. 1*). If the decantation is done carefully there will only be a trace of foam at the top of the jar, and this can be caused to overflow by the addition of a little more juice. The sample is then ready for testing.

The mixed sample collected from the clarifiers is already "clean," but must be cooled before being tested. If the analysis is required on the same day, the sample bottle may be placed in a bucket, half filled with cold water, for an hour. Or, the sample may be left in the laboratory overnight, and analysed the next morning; the juice being prevented from fermenting by the bichloride of mercury previously added.

The Density Test.—This has been fully described in Chapter V., pp. 516-519. We will assume that the temperature of the juice is 78° F., and the reading of the Brix scale 18·2. The reading at 84° F. (or the corrected reading) is, therefore, 18·0 Brix.

The Optical Test.—In Chapter VII., we explained how to use the polariscope, and the principle on which the instrument is graduated.

A portion of the juice (used for the density test) is clarified with basic acetate of lead, as follows: fill a 100-110 cc. flask to the lower mark with the juice, add 5 cc. lead solution from a graduated pipette, and finally, 5 cc. of rain water to dilute the whole exactly to the upper mark. The contents of the flask are next thoroughly mixed by shaking and inverting the (closed) flask several times, and the contents poured upon a fluted filter paper in the apparatus shown in *Fig. 13*. For details of these manipulations the reader must refer to Chapter IV., if he has not already made himself familiar with them.

The observation tube is filled with the clear and almost colourless filtrate so obtained and a series of five polariscopic observations made, from which the mean value is calculated. Another series of five readings must be made with water after the observation tube has been washed free from juice. Let us assume, by way of example, that the juice gives an average reading of 53·7, and the water (or zero point) a reading of + 0·2. The corrected reading of the juice will, then, be 53·7 — ·2 = 53·5.

As it stands, this result has no practical meaning, because, as explained in Chapter VII., the numbers on the scale of the polariscope indicates percentages *only* when the normal weight (26·048 grams) of the sample are dissolved or diluted with water to 100 c.c. Now, the percentage of sugar in the juice may be expressed with equal accuracy in either of two ways, namely, by weight or by volume. In the former case we should require to know the weight of juice entering the factory in order to deduce therefrom the weight of sugar thus *imported*. In the case of percentage by volume, the weight of *imported* sugar can be deduced from the volume of the juice, and the result is most conveniently expressed in pounds per gallon.

To obtain the percentage of sugar by volume directly from the polariscope we should have to measure 26·048 cubic centimetres (instead of grams) into the 100 c.c. measure flask, add some lead solution, and dilute the whole to 100 c.c. Instead of this, we took 100 c.c. of juice, diluted this by one-tenth, and obtained a mean reading of 53·5.

The necessary calculation is not very intricate if made in two stages, as follows :—

(*a*.) The juice was diluted by one-tenth, hence the undiluted juice would have given a reading of $53{\cdot}5 + \frac{53{\cdot}5}{10} = 58{\cdot}85$.

(*b*.) If the undiluted (or 100 %) juice gives a reading of 58·85, a 26·048 % solution of same would give a reading of $\frac{58{\cdot}85 \times 26{\cdot}048}{100} =$ 15·33; and this means that the sample of juice tested contains 15·33 grams per 100 cc.

This result is definite enough to the chemist, but to give it a practical meaning in the factory it is merely necessary to re-state it as under :—

15·33 grams per 100 cc.
= 1·533 ,, ,, 10 ,,
= 1·533 pounds per gallon.*

If we have succeeded in making this clear, it now only remains to reduce our calculation to its simplest form for practical use.

Let R stand for the scale reading of any sample of juice, then $\cdot02865 \times R =$ pounds of sugar per gallon of juice.

In the above example $R = 53{\cdot}5$, and $\cdot02865 \times 53{\cdot}5 = 1{\cdot}532775$. Reducing the number of decimal places to three, this becomes 1·533, the result obtained above.

A very convenient way of abbreviating this calculation is shown below under A.

	A.	B.	C.
Polariscope reading =	53·5	53·0	53·25
	5350	5300	5325
	5682	5682	5682
	10700	10600	10650
	4280	4240	4260
	321	318	320
	27	27	27
	15328	15185	15257
Pounds sugar per gallon =	1·533	1·519	1·526

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*Because 10 pounds of distilled water measure 1 gallon and 10 grams of distilled water measure 10 cc., and these ratios are identical.

Here, the decimal points are omitted and the reading is expressed in four figures by the addition of a final jero. The number 5350 is then multiplied by the number 5682 (*i.e.*, 2865 reversed) in the following manner:—

10700 = 5350 × 2 in the usual way.
4280 = 535|0 × 8.
321 = 53|50 × 6 (adding on 3, which would have been carried forward if the right-handed number (5) had also been multiplied by 6).
27 = 5|350 × 5 (adding on 2, which would have been carried forward if the right-hand numbers (3 and 5) had also been multiplied by 5. Thus:— |35 × 5 = 1|75, and this is practically 2|00).

Under B and C we give two other examples of this short cut.

The Quotient of Purity is the ratio of sucrose to the total solid matters dissolved in the juice, and is calculated from the data already obtained. Thus, the density test gave 18·0 Brix, and this means 18·0 parts by weight of dissolved solids per 100 parts by weight of juice. The question, then, is—how much of this 18% of total solids consists of sugar?

The optical tests indicates 1·533 pounds of sugar per gallon of juice, and we have now to express this in terms of percentage by weight. Turning to Table I., Chapter V., we find that juice of 18·0 Brix weighs 10·707 pounds per gallon, and:—

10·707 : 1·533 : : 100 : x = 14·318% of sugar by weight.

In every 100 parts by weight of juice, there are, therefore:—

Total solids (Brix)..	18·0
Sucrose..	14·318

and 18 : 14·318 : : 100 : x = 79·5 Purity.

THE VOLUME OF THE JUICE.

Arrangements for measuring the juice in the clarifiers were described in Chapter I., but as the juice is to be measured *hot*, certain calculations are called for in adjusting the working capacity of each tank. An example will make this clear.

In a factory designed to treat 300 tons of cane per day, the juice expressed by a three-roller mill is to be measured in eight similar tanks. The internal dimensions of these are: 5 ft. 3 in. × 5 ft. × 4 ft. 8 in. deep, giving a total capacity of 211,680 cubic inches, or 763·5 gallons. Allowing sufficient empty space at the top of each tank for stirring the juice after tempering, we should, in this case, adopt a working capacity of 700 gallons and thus, at the same time, secure a simple factor for calculating the total number of gallons of juice per day.

But, since the volume of any liquid depends on its temperature, all measurements of the hot juice must be corrected for expansion. A simple experiment will make this clear.

Fill a 100 c.c. flask exactly to the lower mark with juice at a temperature of 84° F. Attach one end of a piece of string to the neck of the flask in such a manner that the flask may be suspended in one of the clarifier tanks with only the upper half of the neck above the level of the hot juice. After being thus heated for about 20 minutes, the contents of the flask will have attained the temperature of the hot juice, and it is then observed that the level of the contained liquid has risen perceptibly above the 100 c.c. mark. Hence, if the original 100 c.c. contained 15·33 grammes of sugar, we now obtain, say, 103 c.c. containing the same weight of sugar, or only 1·488 grammes per 100 c.c.

The expansion of sugar solutions by heat has been studied with great care, and we may accept the following data as reliable. If a gallon of juice at 84° F. be taken as unity, then 100 gallons of juice become :—

102·16	gallons	at	180° F.
102·85	,,	,,	185° F.
103·03	,,	,,	190°
103·27	,,	,,	195°
103·45	,,	,,	200°

The temperature of the juice in the clarifiers depends not only on the number and dimensions of the juice-heaters, but varies in proportion as the heating surfaces become coated with scale and dirt. If the tubes are only cleaned once a week, the temperature of the juice may drop from 200° F. on Monday to about 180° F. on Saturday. In this case we must adopt the mean temperature of 190° F., requiring a correction of 3%.

To measure 700 gallons in each of the tanks referred to above these must be filled to such a depth as will give $700 + 3\% \times 700 = 721$ gallons of hot juice. The total depth was stated to be 4′ 8″, and the total capacity 763·5 gallons, or 13·63 gallons per inch in depth. The required depth of juice is, therefore, $\frac{721}{13{\cdot}63} = 4' \, 5''$. "Indicator brackets" (described in Chapter I.) are now attached to the sides of each clarifier in such positions that the pointed extremities of the bracket are 4′ 5″ from the bottom of each tank. When the tanks are subsequently filled so that the surface of the juice just touches the "indicator points" we know that each tank holds as much hot juice as would occupy a volume of 700 gallons at the normal temperature of 84° F.

(To be continued.)

Mexico has applied to the Canadian Government to allow Mexican sugar to enter Canada at the same preferential rate as sugar from the British West Indies. But Mexico is not a British colony, so it is difficult to see on what grounds she claims this special treatment.

MUTUAL CONTROL.

In Java there is a system for the exchange of information concerning the working of the sugar factories there, which is known by the name of "Mutual Control." According to this system, each factory sends particulars to date as to working, comparison of the juice, &c., every fortnight, or, if this is not possible, every month, to the experiment stations, which superintend the system and distribute the results. In order that the different results may be comparable, particulars are given in the first list of the season as to the kind of installation and the modes of clarifying employed. With the same object, all the factories use the same system of chemical control, while their chemists employ, as far as possible, the same methods of analysing the juices, megass, &c., and give the weight of the cane and the measure of the juice without any unjustified correction. In this way, each factory can gain information as to what results are being obtained at the others, and the superiority or inferiority of any one factory is quickly shown.

It would be quite possible to adopt a similar system for the West Indies from Jamaica to Demerara for such factories as possess a complete system of control, that is, the means of weighing the cane, measuring the juice, &c., and a competent chemist provided with a good laboratory. Barbados would be the best centre for the collection and distribution of results, the expenses of printing and posting of which could be covered by an annual fee of eight or ten shillings from each factory, while no numbers of the report would be sold outside.

It should not be difficult to find some organisation willing to undertake the work of receiving and collating the reports. This work might also be done in Demerara or any of the other islands.

The writer will be glad to receive any communication on the subject from any one interested in the proposals.

Antigua, J. Lely.
5th February, 1906.

Particulars to date under the following heads are to be forwarded by each factory to the central station every fortnight.

(Tons are given to two places of decimals; Brix and sucrose percentages to two places of decimals; and purity to one place.)

Tons of cane crushed .. ..
Gallons diluted juice .. ..
Tons ,, ,, ...
Gallons last molasses .. ..
Tons ,, ,, ...
Tons filter cake .. ..
Cane fibre .. ..
Bagasse { Solids .. ..
Bagasse { Fibre .. ..
Bagasse { Sucrose .. ..

	Brix.	Sucrose.	Purity.
Normal juice			
Diluted ,,			
Masse-cuite			
Boiled seconds			
Filter cakes	—		—
First sugar	—		—
Second ,,	—		—
Molasses			

	Amount.	Lost.	Extracted.	Recovered. (Add sugar under treatment.)
Sucrose per 100 cane				

Extraction .. ..
Dilution .. ..
Gallons normal juice per ton of cane .. .. ..
,, ,, ,, ,, all sugars .. ....
Sucrose recovered per 100 sucrose in juice (only sugars) .. ..

Particulars to be Given at the Commencement of Each Season.

1. Type of cane feeder.
2. ,, crusher.
3. ,, two-roller mill.
4. ,, three-roller mill.
5. Maceration, if employed, hot or cold ?
6. ,, ,, after which crushing.
7. System of clarification.
8. Chemicals employed besides lime, and where they are used.
9. Method of treatment of the thick juice—elimination or filtration ? If filtration, state type of filter.
10. Type of evaporators.
11. Method of after crystallization of 1st masse-cuite.
12. ,, ,, ,, ,, 2nd ,,
13. System of centrifugals for 1st sugar.
14. ,, ,, ,, 2nd ,,
15. How the molasses are disposed of.
16. Name and address of company by whom the factory was built and the machinery supplied.
17. System of boilers employed.
18. Name of manager.
19. ,, superintendent responsible.
20. ,, chemist responsible.

The particulars are suitably collated and a copy forwarded to each member.

The form is left blank in the case of particulars which cannot or may not be given.

HATTON'S PATENT DEFECATORS.

On the accompanying plate we illustrate in sectional elevation one of Hatton's Patent Continuous Cane Juice Defecators, of which we understand the sole licensed manufacturers in the United Kingdom are Messrs. Fawcett, Preston & Co., Ltd., of Liverpool. It has several interesting features, and a short description of the same will not be out of place.

The Hatton system of defecation was first tried in Santo Domingo; and its early success there led to its introduction into Cuba in 1900. Here it came under the notice of a member of the above mentioned firm who was so impressed with it that he secured the sole rights of manufacture in the United Kingdom.

The juice from the mill is limed cold to the degree desired and found most advantageous, and then flows in a constant and steady stream by the juice pipe A through the regulating cock B, into the defecator by the pipe C, which delivers it at the bottom of the copper double bottom of the Defecator. As the defecator fills up, the juice overflows and fills the vessel D, which is closed at the bottom. The juice then finds its way up the internal pipe E, and so away by the discharge branch F, into the clear defecated juice canal, whence it passes direct to the supply tanks, feeding the multiple effect evaporator. If it is desired to treat the raw juice with sulphurous Acid Gas, it is put through the gassing tower before it is limed.

The limed juice being delivered in a constant stream to the Defecator, and the heat being maintained in it at the desired temperature, the effect of the combination is as follows:—

Instead of discharging cold juice in the ordinary manner on the top of the juice already partially heated, and so producing counter currents of an objectionable nature, the juice flows in a steady stream into the Defecator at the bottom, where it is immediately heated, and rises of its own accord without meeting any down currents.

The scums form, as they rise, a thick layer on the top of the liquid, and prevent any loss of heat from its surface, or inversion by exposure to the atmosphere.

The juice flows over the edge of the vessel D to the bottom thereof without carrying down any of the light vegetable matter in suspension, so that the juice ascends the internal pipe and goes away from the Defecator in a clear state.

The vegetable impurities, always floating and ascending, collect under the mass of scums and add to them, with the curious result that although the heat never exceeds 210° Fahr., the scums become comparatively dry and are pushed up several inches above the rim without overflowing.

These scums are removed from time to time as they collect, and as found convenient, and are sent to the fields as manure. They only contain a trace of sweets, and not sufficient to make it worth while treating them further in filter-presses or otherwise. Any earthy or other matter that may be precipitated during the process, and fall to the bottom, might, if left there, interfere with the heating efficiency of the copper bottom. They are therefore removed once in two hours by gently revolving the scraper, and so loosening the incrustations which are carried up with the other impurities.

It is claimed that the Defecator, under these conditions, can work continuously for several days and nights. But if work is not carried on at night, a little lime scattered over the top of the scum cake will prevent any deterioration of the juice, while the scum cake itself will prevent any appreciable loss of heat, which is also maintained by a self-acting steam valve with which the pan is fitted.

In order to secure an efficient separation of the juice on the one hand from the scums which float to the top, and on the other hand from the heavy impurities which sink to the bottom, it is necessary to provide in ordinary double-bottom defecators, as usually worked, a total capacity of at least double the number of gallons of juice to be defecated per hour. Thus an estate expressing 5,000 gallons of juice per hour would need 10 Defecators of 1,000 gallons capacity, and two hours would be required for the series of operations in each Defecator.

But the makers claim that in a Defecator of 1,000 gallons capacity, fitted under the Hatton system, 12 minutes are required to fill it up, after which 1,000 gallons of juice run out of it in a steady stream per hour, so that only half the capacity of Hatton Defecators is required to deal with the same quantity of juice.

The out-flowing juice is perfectly clear and defecated, because during the whole time the juice is in the Defecator, it is exposed to a temperature of 210° Fahr., which is kept constant by means of an ingenious Heat Regulator consisting of a copper pipe closed at one end and fixed inside the Defecator. This copper pipe follows the curve of the bottom of the defecator and is filled with water. The expansion and contraction of the water in this pipe causes the diaphragm in the Heat Regulator to rise and fall, and shuts off or opens the steam inlet valve, which is of the balanced type. This simple contrivance has proved most efficient in the numerous cases in which it has been adopted.

Since their introduction, 154 Hatton Defecators have been set up in Cuba on 15 estates, turning out in the aggregate 787,000 sacks of sugar, or about 112,400 tons per crop.

The sugar crop of Mauritius has been estimated at 180,000 tons, or 40,000 in excess of last year's crop. The low prices obtained have, however, proved very disappointing and only a small margin of profit has been gained.

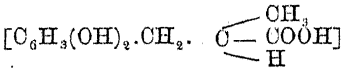
GLUCINIC ACID.

One of the most interesting constituents of cane sugar molasses is glucinic acid, which is present in all concentrated products which have been exposed to a temperature exceeding 65° C. Its constitution is still a matter of doubt, although Reichardt described it in 1870.

The following methods of preparation are given in Watts' Dictionary of Chemistry, Vol. II. (1890 Ed.), p. 612: (1) Saturate glucose solution with lime or baryta and leave it for several weeks. Add basic lead acetate, which produces a bulky precipitate of lead glucinate. (2) Melt glucose in its own water of crystallization at 100° and mix with warm concentrated potash solution; when the first reaction has ceased, precipitate with lead subacetate. (3) Boil cane sugar with dilute sulphuric acid in contact with air. Filter, neutralize with calcium carbonate, evaporate to dryness (!), dissolve in a little water and mix with alcohol, when calcium apoglucinate is precipitated, while calcium hydroglucinate remains in solution (Mulder). It becomes brown when boiled with sulphuric or hydrochloric acid, apoglucinic acid being among the products. According to Grote and Tollens, the product obtained by Mulder's method is not glucinic acid, but calcium laevulate [$C_5H_6(CaO)_3$]. That it is not the glucinic acid of sugar molasses is evident, as it would have been decomposed during the evaporation to dryness.

Reactions in which Glucinic Acid is formed.—(1) If glucose is heated with potassium hydroxide or caustic soda, decomposition sets in at a temperature between 60° and 70° C., and on boiling for a long time, complete destruction results. If a dilute glucose solution is mixed with an alkali, the alkalinity disappears, slowly in the cold, rapidly when hot, the temperature in the latter case not exceeding 80° C. The liquid reduces Fehling's solution even at ordinary temperatures. On standing, it absorbs oxygen, becoming yellow or brown in colour and developing heat, while the salts of two acids, glucinic acid and "saccharum saüre" [$C_{14}H_{18}O_{11}$(?)] are formed. (2) When glucose is heated out of contact with air with baryta, it gives acetone, and barium glucinate finally remains (Kawalier). This is also formed, with production of heat, when glucose is heated with crystallized baryta at 100° C. On heating glucose with hot saturated baryta, dissolving the product and decomposing it with an acid, we get, in addition to glucinic acid, melassinic acid. Heating glucose with three times its weight of baryta and a little water at 160° C. causes 60% of it to form lactic acid; at 240° C. it decomposes, without developing gas, into formic, acetic, oxalic, lactic and protocatechnic acids, pyrocatechin and, probably phloroglucin. (3) Kawalier also states that polysaccharides, of which one constituent is glucose, will give glucinic acid among the products of decomposition; among these are saccharose, lactose and raffinose. In addition, according to others, galactose and mannose, and of course in a high degree, invert sugar give the same products, as Winter has proved by his interesting experiment (See below). Weak laevulose, especially, which is readily oxidized in cold solutions, is easily transformed.

Reactions of Glucinic Acid.—(1) If, according to Prinsen Geerligs, a solution of the *neutral* calcium salt is heated on a water bath, it suddenly begins to froth at a temperature of 85° C. evolving carbon dioxide and a stinking gas, leaving formic, acetic, humic and apoglucinic acids, the solution becoming at the same time dark in colour and strongly acid. Herzfeld did not find the decomposition so simple, but he confirmed an experiment by Winter which was conducted as follows:—A 1 % invert solution was carefully heated with 0·5 % calcium hydrate, when a white, bulky, viscous, basic lime salt was formed. This cannot be filtered and, on further heating it dissolves, finally decomposing and forming a brown solution in the presence of air. It is purified by decanting and adding lime solution from time to time, out of the presence of air, a long time being allowed to elapse between each addition. In this way, it is obtained as a pure white mass from which the free acid is prepared by decomposing the salt with dilute sulphuric acid and extracting with ether. Prepared in this way, it forms very hygroscopic needle-shaped crystals which, while standing over sulphuric acid, first liquify and then recrystallize, forming crystals similar to those of saccharose, thus suggesting that atomic intermigration has taken place. Finally these decompose into formic, carbonic and apoglucinic acids. The glucinic acid prepared in this way is probably identical with the one which occurs in molasses. It was found to reduce Fehling's solution when cold, decompose when heated and to dissolve easily in water, alcohol, chloroform and ether, properties which were confirmed by Herzfeld except in regard to its solubility in the last-mentioned liquid. (2) In connection with the decomposition reactions of glucinic acid, their immense complication is shown by the following observations of Allein and Gand:—Glucose is, by simple loss of water, decomposed into glucinic acid [$C_{12}H_{18}O_9$], which itself easily decomposes into pyrocatechin [$C_6H_6O_2$] and gluconic acid [$C_6H_{12}O_7$] which latter partly oxidizes to dibasic saccharic acid ["Zuckersaüre"-$C_6H_{10}O_8$] and partly splits up into lactic acid [$C_3H_6O_3$] and glyceric acid [$C_3H_6O_4$], the last one again giving lactic acid and oxalic acid [$C_2H_4O_2$]. Lactic acid partly gives tartronic acid [$C_3H_4O_5$], which with carbonic acid forms dioxytartaric acid and, further again, pyrocatechin. At this stage, some of the unchanged lactic acid, by condensation with pyrocatechin, yields $C_6H_3(OH)_2(CH_2)_2COOH =$ dioxyphenylpropionic acid, a methylhydrocaffeic acid,



$$[C_6H_3(OH)_2.CH_2.\ C \begin{cases} CH_3 \\ COOH] \\ H \end{cases}$$

and this, by loss of carbonic acid, forms $C_6H_3\ (OH)_2.CH_2.CH_2.CH_3$. From comparison with other observations it is evident that the decomposition products are not always the same, either as to kind or quantity, formic and acetic acids being among them in addition and, of the higher combinations, caramellin and humic acid.

More particulars, of later date, are given by Lippman in his well known "Die Chemie der Zuckerarten." Glucinic acid is, according to Dubrunfaut, $C_{12}H_{18}O_9\ H_2O$, according to Reichardt, $C_{12}H_{22}O_{11}\ H_2O$. It is tribasic and forms a bitter syrup soluble in water and alcohol. It gives a characteristic blue violet colour with iron salts such as ferric chloride. The alkali salts, the formula of which is very uncertain, are soluble, forming a brownish red solution which reduces Fehling's solution slightly. The salts of lime are yellow and are precipitated from an alcoholic solution by lead sub-acetate and from an aqueous solution by silver nitrate and mercurous nitrates, and barium chloride. They reduce Fehling's solution to the same extent as glucose (Dubrunfaut). The acid itself is a negative molasses former.

Froth Fermentation.—As has been stated, glucinic acid, when heated to temperatures above 65° C., decomposes into formic, acetic and carbonic acids. This decomposition has been named "froth fermentation," though it is not true fermentation, for sterilizing the molasses does not prevent it. "Froth fermentation" is prevented by employing double carbonatation, for if the first carbonatation is carried on until the juice subsides rapidly and in a clear condition while still alkaline, the temperature not being above 65°, the whole of the acid is removed (a fact that is evident when it is recalled that it is precipitated as a basic salt by lime) so that froth fermentation is prevented from occurring during the second carbonatation; it does not take place during the first owing to the low temperature. If double carbonatation is not employed, the following procedure may be adopted: (1) Work rapidly. (2) Leave no strikes hot in the pans or mixers. (3) Boil with a full vacuum (24 in.). (4) Do not use an excess of lime in clarifying. (5) Do not put lime in the syrup or molasses; this reduces the quality of the syrup and there is, moreover, a loss of lime and sugar. (6) Blow the molasses up with steam and skim the dirt off until the surface is clean and black; it is most important that the skimmings should be thrown away. (7) Let the air pump run through for seven to ten minutes after steam is shut off. By such means frothing is almost sure to be prevented, so much so that tanks in which molasses is standing may be filled to two to four inches from the rim.

Molasses cannot be freed from glucinic acid by the use of either normal lead acetate or by the basic salt. This may be proved by clarifying the molasses with these, and, after freeing the liquid of lead and evaporating it to a thick syrup, adding five volumes of alcohol, by which pectine is precipitated; after two days' settling, glucinic acid is found in the alkaline filtrate.

I have, on one occasion, seen a vacuum pan cracked by the pressure of the gas evolved during froth-fermentation. The molasses strike, which had been boiled at too high a temperature, was left in the pan, all valves, &c., being shut; after three days the pressure became so great that the pan gave way. At the same time, a strike left in the other pan at 44° C. did not show any frothing. The strike which caused the injury to the pan was difficult to cure, and gave a very poor return, showing, contrary to what Prinsen Geerligs says, that froth fermentation has a harmful effect on the masse-cuite.

Decomposition of the glucinic acid is, of course, taking place during the boiling process, but it is not conspicuous because the products escape observation. There is very little decomposition as long as the solution of the impurities is not very concentrated, but, when boiling for last molasses, the glucinic acid, which cannot exist in a concentrated form at the temperature, begins to decompose more rapidly as more sugar crystallizes, and the impurities become more concentrated. It has been noted that this decomposition is possible even at ordinary temperatures (about 30° C.) when the liquid is alkaline, especially if the alkalinity is due to the pressure of lime. As will be evident from what has been said, there is some confusion in the literature of the subject as to the properties of glucinic acid, and it is my opinion that, as there are sixteen possible isomers of glucose, all of which have been made synthetically, it is in the same way quite possible that there is more than one isomeric glucinic acid. That more than one glucose is present in cane juice is proved by my own observations, with purities over, or quite near, one hundred in mill juice, made at the Poerwodadi Sugar Factory, Madioen, Java, which show in addition that these glucoses are unstable. The particulars are as follows:—

JUICE IN THE TRIPLE EFFECT.

	I.	II.	III.	I.	II.	III.
Brix (Total Solids) ..	22·87 ..	27·50 ..	43·80 ..	18·0 ..	27·0 ..	44·0
Sucrose (Polarization).	21·28 ..	25·16 ..	39·185 ..	16·52 ..	24·68 ..	39·82
Purity..	93·05 ..	91·50 ..	90·90 ..	91·8 ..	91·4 ..	90·5

The amount of glucose present did not change in any instance.

Purity of Juices.	Purity of Syrup.	Purity of Juices.	Purity of Syrup.
97·62	89·3	98·1	—
97·9	89·8	103·4	—
96·3	—	89·4	96·3
96·7	—	89·9	93·6
96·6	—		

It will be seen that the last two observations are of a nature contrary to the first.

In addition to the possibility of there being several glucinic acid isomers, it is very likely that one of them can be formed from another by atomic intermigration. Such a fact would explain why, while observers attribute different properties to it, they all agree that *it is a very unstable body, as regards its constitution.*

J. LELY.

CRYSTALLIZATION IN MOTION *v.* CRYSTALLIZATION AT REST.

The Hawaiian Sugar Chemists' Association has lately been investigating the merits of Crystallization in Motion as compared with the older method of Crystallization at Rest. Their Chairman of Committee, Mr. E. E. Hartmann, has just issued a detailed report on the result of his investigations, and as this is a question of considerable interest at the present day, we venture to reproduce below his remarks and the conclusions he has arrived at. We are indebted to *The Planters' Monthly* for our information.

I beg herewith to submit my report on "Crystallization in Motion *v.* Crystallization at Rest." It was my original intention to compile and tabulate the results obtained at the various factories in these islands in connection with the types of boiling and crystallizing devices and their respective capacities. With this object in view I sent to the members of this Association a circular with a set of questions covering these points. But few answers were received and of these only four from factories using crystallizers. These reports, however, shed a great deal of light on the question.

The statements sent in did not lend themselves for tabulation, and this is not surprising, as there are as many modifications of the process called "Crystallization in Motion" as there are factories using crystallizers.

The success or non-success of the process depends primarily upon the work done in the pans. Uniformity of the grain is a *conditio sine qua non*, as is also a complete chemical control.

Next in importance is the cooling of the masse-cuite. The process of cooling must keep pace with the exhaustion of the mother liquor, in other words, the saturation of the mother liquor must be kept constant. If the cooling is conducted too slowly, a portion of the recoverable sugar will be retained in the mass, as then the viscosity of the mass increases at a greater ratio than the attenuation of the mother liquor. According to Horsin-Deon, the viscosity is the inverse function of the temperature. If on the other hand the cooling takes place too rapidly, formation of false grain will be the inevitable consequence.

With the above-mentioned conditions satisfied, excellent work is being done in Java, where with moderate equipment the masse-cuite is separated into sugar polarizing 97 and over, and waste molasses with an apparent purity of little over 30. Among the large number of factories I visited in that country some years ago, the one at Tegowangi took first place in regard to boiling and crystallization;

particular interest will therefore attach to a description of the methods in use there. Mr. C. R. F. Andree de la Porte, the manager of that factory, outlines his *modus operandi* as follows :—

"As little lime as possible should be used for defecation, so that the clarified juice is barely alkaline. The sediment (the mud) is again mixed with lime and thoroughly boiled (preferably by blowing steam into it), the quantity of lime being just sufficient to allow of easy filtration. Care should be taken that the syrup is always kept alkaline.

"The most important part of the work is done in the vacuum pan, grain is formed as low in the pan as possible, and care taken that this grain grows regularly. False grain is easily formed. When the desired amount of masse-cuite is made, it is boiled down to 95° or 96° Brix and—by shutting off the injection water—heated to 70° C. The molasses—previously heated to 80° C.—are drawn in now."

If the molasses supply tank is on a lower level than the pan, the molasses have to be mixed with water or then a pump has to be used for feeding them into pan. The molasses are drawn in little by little, and every time boiled down on the grain, until the finally desired density is reached. This latter is usually 95° to 96° Brix. Before discharging the masse-cuite is heated to 70° C. When the density of the masse-cuite is 97 or over, it is advisable to add waste-molasses.

The crystallizer must be heated to 70° C. before the masse-cuite is allowed to run into it. After half-an-hour or one hour cold water is admitted and allowed to run continuously for 18 or 24 hours. It is necessary to know beforehand the purity of the mixed masse-cuite, which gives the best results. At Tegowangi and at some other factories in the province of Kediri the most satisfactory results were obtained with the following mixture: Brix 96°, Purity 69. This mixture is obtained from juices and molasses of various purities by aid of the following formula :—

$$X = \frac{\text{Capacity of pan (in gallons)} \times (69 - \text{Purity of Molasses})}{\text{Purity of Original Masse-cuite} - \text{Purity of Molasses}}$$

X = Number of gallons of Original Masse-cuite.

Purity of Molasses to be determined beforehand.

Purity of Original Masse-cuite = Purity of Syrup.

"A scale is placed outside of the vacuum pan, which shows the contents thereof at any given height. It is advisable to prepare this scale before grinding time by drawing known quantities of water into the pan."

The masse-cuite is naturally more or less tough and the centrifugals must run at a minimum speed of 1200 revolutions.

The following table represents a type of the work done and the manner of recording it :—

Date.	Pan number.	Current Number.	Boiling time hours.	Purity of Syrup.	Purity of Molasses taken back.	Purity of Masse-cuite.	Temperature of Massecuite °C.	Purity of Run off Molasses.	Proportion of Molasses.	Number of hours in Crystallizer.	Masse-cuite Brix.
July 12..	2	176	10	79	38·0	63·5	48	31·0	90 in 145	16	98·0
,, ,, ..	1	177	10	79	37·5	64·4	47	36·3	90 in 145	17	95·5
,, ,, ..	3	178	11	79·5	37·0	64·8	49	32·7	90 in 145	12	97·5
,, ,, ..	2	179	12	79	36·5	62·2	48	31·7	89 in 145	17	98·0

The average daily output was 90 tons of sugar of 97° polarization, the equipment briefly as follows:—

Three vacuum pans of 3300 gallons capacity each, 560 square feet of heating surface in each, with coils of 5·6 inches diameter and outlets of 20 inches diameter.

Six crystallizers of the same capacity as the vacuum pans.

Twelve 30-inch centrifugals.

Ten molasses tanks of 1760 gallons capacity each.

The crystallizer shaft makes two revolutions per minute.

In order to prevent the molasses from becoming acid, a 1° Bé. spraying solution of caustic soda is applied in the centrifugals. Out of three crystallizer charges the molasses of one is thrown away. The masse-cuite for this one is boiled particularly heavy, and the steaming of the pan are not run into the same crystallizer.

The manipulation of pans and crystallizers must to a great extent be left to the judgment of the chemist in charge. Horsin-Deon, Herzfeld, and others have constructed formulæ and tables, by which the relation between density, temperature and proportion of sugar crystallized may be determined at any given moment. Commenting on his own figures the former says: For more or less impure solutions others conditions hold; but for the almost pure solutions commonly handled they will be found not inaccurate." Based on similar calculations Claassen patented a process for regulating the supersaturation in the crystallization of impure sugar solutions. A description of this process is to be found on page 142, Vol. V., of the *International Sugar Journal*. It is well worth reading, although the figures apply to beet products.

Where crystallizer goods are made for shipment, it is necessary to dry the sugars after they come from the centrifugals in order to prevent or check fermentation. Experience has taught us that, if this precaution is neglected, the sugars frequently, or even generally deteriorate in transit. Crystallizer goods must be washed in order to attain the required polarization; the water dilutes the molasses adhering to the grains and renders them a fair medium for the growth and propagation of all kinds of bacteria and fungi.

The better the exhaustion of the molasses, the lower will—*caeteris paribus*—be the polarization of the unwashed sugars in the centrifugals, and the greater the quantity of wash water needed to bring the sugar up to the required standard. A certain quantity of sugar will thereby be redissolved. A loss from this cause may be prevented by the use of double gutters under the centrifugals. A great many of these are in use in Java, and, as shown by Mr. Johnson's report, the arrangement gives satisfaction at Waialua. It is, of course, impossible to completely and perfectly separate the green from the diluted molasses. With the ordinary centrifugal the separation is very incomplete indeed.

A number of machines, for which it is claimed that they give improved separation, have been designed and patented. The first successful attempt was patented in 1897 by Dobiecky. Other patents have since been taken out for improvements or machines built on an entirely new principle by Thomas Law Patterson (England, 1898), Adolf Holland (Germany, 1901), and several others. A device patented by W. Th. Mathieuwissen was investigated in 1901 by a commission of the Java Planters' Association. This commission concluded its report as follows:—

"These figures show plainly, that a good separation between the green and the diluted molasses has taken place. The whole arrangement has made a good impression upon us, and we are of opinion, that good results may be expected from it, particularly in factories where muscovado is not the only product."

It has also been proposed to use two sets of centrifugals in this manner:—The discharge of the first set is intimately mixed with molasses of high purity, and this magma run through a second set. This method, while certainly efficient, seems to require rather too much machinery to be practicable.

The advantages of crystallization in motion are inversely proportional to the quality of the desired product. The sugar, which under other circumstances would have been recovered in a second grade, goes to increase the size of the crystals already present. The nucleus of the crystal, which has been formed from pure syrup, is white, the outer layers are more or less coloured according to the colouration of the molasses surrounding the grains. This is explained by the nature of crystallization itself. Successive layers of sugar are deposited on the crystals from the mother liquor. During this process small quantities of the mother liquor are occluded or retained as films between the layers of sugar. The quantity of molasses thus occluded is proportional to the surface area of the individual crystal, so that more of the mother liquor is occluded in the large crystals than in the small ones. This is a phenomenon, which has to be reckoned with, if white sugar is to be turned out.

The masse-cuite is kept in motion in the crystallizer by a stirrer making one revolution in from one to two minutes. The speed, which gives the best results, has, like many other points, to be determined locally.

If the main object of the process—*i.e.*, feeding the grain already present instead of forming new grain—is kept in view throughout all the manipulations, satisfactory results may with confidence be expected from this method of crystallization.

In deciding on the merits of the two ways of working it must be borne in mind, that the purity of the molasses alone cannot be taken as a criterion. Prinsen Geerligs has shown that crystallization in motion does not affect the quantity of sugar crystallized, but the form in which it crystallizes. This is best illustrated by a comparison of the results of some experiments made by Prinsen Geerligs. The figures here given represent averages of a number of tests:—

	Crystallization.	
	At rest.	In motion.
Purity of masse-cuite	84·1	83·4
Purity of molasses	44·0	46·4
Water % molasses	24·6	22·9
Sugar crystallized	66·3%	64·0%
Amount of crystals obtained in centrifugals	55·2	64·0
Loss of crystals in curing % sugar	16·7	0

These tests show clearly, that with crystallization in motion all the recoverable sugar was deposited on the existing grain, in which form it was completely retained in the centrifugal, while in the coolers new grain to the extent of one-sixth was formed, which passed through the screen.

In one of the factories in Hawaii I compared the run-off from the centrifugals with the molasses drained from the same No. 4 masse-cuite through fine wire gauze. The apparent purity of the former was 38, that of the latter, 30.

The loss of sugar caused by the passing of fine grain through the centrifugal screens can of course be avoided if the crystals are separated by drainage. In Java, the masse-cuite is filled into sacks made of matting, and the molasses are allowed to drain through the meshes during months, hence the name "Sack-suiker."

This method has been improved upon by Maurice Lambert, who describes his process, which has been in use at the Toury Refinery, in France, for five years, as follows:—

"The runnings from the first products are concentrated in vacuo at 90° C. to 40° Bé., then drained off and passed into so-called crystallizers, wherein the masse-cuite, without any stirring, crystallizes out fully in 24 hours. The chief role in this process lies in the crystallizers; these consist of trapeze-shaped receptacles, which, with their partitions, are made of sheet metal. The bottoms possess conical openings, which can be closed when required. At the end of 24 hours, a large amount of very fine crystals has formed in the mass, and cooling has rendered the contents very concentrated. Hereupon the bottom apertures are opened, and the molasses drained off. This draining lasts 70 to 80 hours, after which the bottom doors are again closed. The masse-cuite remaining in the crystallizers is then dissolved in second saturation juice. By means of a circulating system the juice can pass repeatedly through the crystallizer, entering at the bottom and spreading through the sugar mass; after being sufficiently concentrated it flows off at the top through a drain pipe. Lest the juice should get cold during circulation it passes through a heater previous to entering the crystallizer. The circulation is fully automatic, so that very little supervision is needed. When the sugar solution in the crystallizer attains a concentration of 28° to 30° Bé., it is filtered and ready for further treatment."

This process does not appear to me to be suited for cane products. It does not eliminate the one objectionable feature of every modification of crystallization at rest, and that is the inevitable formation of layers of different temperatures and different densities. It is evident that the mass cools more rapidly on the outside. The quicker the cooling, the quicker will be the separation of crystals from the mass, causing an increased attenuation of the surrounding medium. Another important factor affecting the condition of the mass is the latent heat given off in the transformation from the liquid state to the solid, or the heat of crystallization. The rule, that the best crystals are to be obtained from a solution, which is kept in perfect tranquility, has many applications; but it does not hold good in the case of cane-sugar house products. It is evident that such stratification can not take place if the mass is kept in continuous motion from the time the crystals are formed. The motion must be continuous, for, should such layers be allowed to form, the subsequent agitation would cause a sudden separation of floury crystals from the supersaturated mother liquor; in other words, intermittent agitation would cause the formation of false grain.

Thus both theory and practice point to the superiority of crystallization in motion over the old process of boiling several grades, leaving all except the first to crystallize in coolers or in tanks.

Its advantages may be summed up as follows:—

1. The yield in marketable sugar is undisputably larger.

2. The process is simpler and much more cleanly.

3. The finished product is more uniform, it is moreover proof against deterioration in transit.

4. The froth fermentation of after-products is avoided.

5. The exhaustion of the molasses—if not throughout more complete—is more uniform.

6. The waste molasses are of greater value for feed; they are not fermented and strongly acid as molasses which have been standing in tanks for months usually are.

7. A saving is effected in interest, as the sugar becomes available within a much shorter time.

It has been urged that the practice of boiling back molasses causes deterioration of the latter and consequent loss of sugar. Prinsen Geerligs showed by a series of experiments made with a view of settling this point, that there is no difference in the composition of the molasses, and that therefore boiling back has no perceptible detrimental effect.

The only thing that can be said for the old process is that it can be worked by rule of thumb, while the success of the new process, based on scientific principles, depends entirely upon scientific control. Where the services of a well qualified sugar house chemist are not available, nothing can be gained by substituting crystallizers for coolers.

ERNEST E. HARTMANN.

Amongst the answers sent in, in response to Mr. Hartmann's circular, we give the following two:—

Mr. Horace Johnson, of Waialua, wrote as follows:—

The Waialua mill is equipped with three 25-ton Kilby vacuum pans, sixteen Kilby crystallizers, holding 7000 gallons each, eighteen 42-inch water driven centrifugals, two Hersey dryers.

The method of boiling is along the lines of the so-called Java process. We find that we obtain the best results by boiling two grades of masse-cuites. That is by first boiling a strike consisting of such proportions of syrup and molasses of ca. 44 purity as to yield a masse-cuite of ca. 68 purity. This masse-cuite remains in a crystallizer for twelve to sixteen hours, being cooled by the aid of water jackets to about 38°C. This masse-cuite yields a molasses of ca. 44 purity and a sugar which, dried after slight washing, polarizes 97-98.

From time to time, depending on the amount of molasses on hand, a second masse-cuite is boiled with such quantities of syrup and molasses of ca. 44 purity as to yield a masse-cuite having a purity of ca. 56.

This masse-cuite remains in a crystallizer for twenty-four to thirty hours, being cooled to about 40°C. When centrifugaled, this masse-cuite yields a molasses of ca. 33 purity and a sugar which, after washing, polarizes 96·5-97.

The sugars from the two strikes are mixed as they leave the dryers and shipped as one grade, the average polarization of which is 97-97·5.

The molasses and the wash water from the second strike are separated by a system of double troughs. The undiluted molasses are thrown away and the wash water molasses re-boiled with the next low grade strike.

As is seen by the above outline, we make two grades of masse-cuite, obtain sugars which polarize 97-97·5 and contain ·45% of moisture, and a final molasses of ca. 33 purity.

The time of boiling averages nine hours for the first masse-cuite and eleven hours for the second masse-cuite. The capacity of the boiling house, when this process is used, is 130 to 140 tons of sugar per day.

The reply of Mr. J. N. S. Williams, of Puunene, contained the following information :—

As to outline of method of boiling: first sugars are boiled to a masse-cuite containing 6% to 8% of water, dry second sugar is drawn in during every strike, also No. 1 molasses, the masse-cuite having an apparent purity of 82 to 85. No. 1 masse-cuites are dried direct from the pans. Only one grade of sugar is made.

The boiling is done in four pans holding 50 tons of masse-cuite each and one pan holding 35 tons of masse-cuite. These pans are at work during the whole of the 24 hours. The time required for boiling a strike of No. 1 varies from 7 to 12 hours. A strike of No. 2 or crystallizer goods takes about 11 hours to boil.

There are 12 crystallizers of 1200 cubic feet capacity each ; the water jackets are not used. The masse-cuite remains in the crystallizer for 6½ days on an average. The average daily production of crystallizer goods amount to 2400 cubic feet of masse-cuite, which yields about 48% of its weight in dry No. 2 sugars polarizing from 89 to 92. The crystallizers make 24 revolutions per hour.

No. 2 sugars in daily work are drawn back dry into the pan, and are not washed; but occasionally No. 2 sugars polarizing 92 with good grain are washed and marketed. In conclusion Mr. Williams says :—

"Crystallizer masse-cuites are boiled to 64-68 apparent purity and a density of 92-94 Brix. We find invariably, that we can obtain the same recovery in weight of dry sugar from crystallizer masse-cuites after having been in operation six to eight days as we can from cooler cars of 20 cubic feet capacity after having stood for say 20 to 24 days; but there is this difference: the crystals of sugar from the closed crystallizer are harder and sharper and washed up with less loss than the crystals from cooler cars ; this is a late experience, but it is true. Our conclusions are, that crystallizers are much more economical and cleanly than cooler cars are, and it is possible to make a marketable sugar direct from the crystallizer from a low grade masse-cuite, which is not the case with cooler cars."

Messrs. D. Stewart & Co., Ltd., Glasgow, have secured the contract for a complete sugar factory for the Silveria Sugar Company, of Cuba. It will have a capacity of 2,250 tons of cane per day of 22½ hours.

A REVIEW OF THE SUGAR INDUSTRY IN ANTIGUA, AND ST. KITT'S-NEVIS, FROM 1881-1905.

In a recent number of the *West Indian Bulletin* the Hon. Francis Watts, C.M.G., publishes a review of the sugar industries of Antigua and St. Kitt's-Nevis. These islands have no prosperity apart from sugar cultivation, and at this juncture, when the Brussels Convention has wrought such a material change in the conditions governing the world's sugar market, it seemed desirable that a critical examination of these industries should be undertaken. This Dr. Watts has proceeded to do.

The period from 1881 to 1894 may possibly be taken as indicating Antigua's normal production under the existing acreage. The average annual production during this period was 13,113 tons, and its average value £163,700, or £12 9s. 8d. per ton. But from 1895 onwards matters were less satisfactory, being marked by a succession of small crops and low prices. During the ten years ending 1904 the average annual production of sugar was only 10,205 tons, and its average value £83,370, or £8 3s. 4d. per ton. This drop in prices has proved a very serious matter, as the gross annual income has been thereby reduced by no less than 50·9 per cent. But as circumstances point to a continuation of low prices, an average of approximately £8 per ton must rule for some time to come.

The most disastrous crop was that of 1895, when both quantity and price fell, the former by 50%, the latter to one-third the average of the previous 14 years. The fall off in quantity was occasioned by a combination of drought and cane disease which nearly extinguished the sugar industry, but fortunately the next year's crop was above the average.

Cane diseases played an important part in reducing the crops from 1894 to 1898. In 1895 rotten canes were everywhere prevalent and very little sugar could be produced. That this was not due to drought was shown when in the following season, which was a wet one, cane diseases were still rampant. In 1897 and 1892, the crop was nearly up to the average; while the 1903 and 1904 crops were less so, and that of 1905 was disastrously short.

Dr. Watts says it is "abundantly clear that within recent years Antigua has experienced an unusual share of difficulties owing to unpropitious seasons. It is only reasonable to suppose and to hope that a series of more propitious seasons may again visit the island in the future as has happened in the past, and that the sugar crop may again reach, or exceed, the average of the period 1881-94, namely, over 13,000 tons a year."

As is known, a central factory was recently erected at Gunthorp's at a cost of £52,500, and Bendals sugar factory was converted into a small but well-equipped modern establishment at a cost of £12,00 Both schemes have proved successful. Moreover two sets of steam ploughing plant have been introduced and the deeper cultivation o the soil which these will allow should tend to minimise drought.

"We are therefore justified," concludes Dr. Watts, "in making some forecast of the future, and may reasonably hope to see the sugar crop in Antigua not only reaching to, but, by virtue of the improvements now introduced, exceeding the crops of 1881-94; that is, exceeding on the average 13,000 tons. The price of sugar will doubtless be low, but at £8 per ton, at which price in an average year sugar can be produced at a small profit, this is worth £104,000, while there will probably be a steady increase in the amount of crystal (vacuum pan) sugar produced, and a diminution of muscovado, thus increasing the value of the output. In addition to this, we may look forward to those developments which are sure to arise when the planting body is stimulated to a degree of activity exceeding anything which has existed in the past. Increased areas and improved methods of cultivation, improved varieties of canes, and various other improvements, such as may be anticipated from the intelligent working together of a well-equipped Department of Agriculture and active and alert planters, cannot fail to result in beneficial changes."

To turn to the sugar industry of St. Kitt's-Nevis, we find in one respect a broad similarity between the conditions prevailing in the two presidencies; both had an earlier prosperous period, to be followed by one of depression. From 1881 to 1894 the average production of sugar in St. Kitt's-Nevis was 16,078 tons and the gross annual value was £198,442 or £12 6s. 2d. per ton. During the period 1895 to 1904 the average annual production was 12,884 tons, having an annual value of £104,297, or £8 1s. 10d. per ton. The average amount of sugar produced during the latter period is 80·1 per cent. of that of the earlier one, while its value is only 52·5 per cent. This shows that in both Antigua and St. Kitt's-Nevis the sugar industry has for some time past been carried on on about one-half of the monetary income to which they were accustomed. In both presidencies great economy has been practiced and reduction in expenditure has been carried as far as possible; now an increase of production by an expenditure on improved methods is a plan favourably received amongst estate proprietors. In this connexion there is little doubt that St. Kitt's-Nevis will follow the example of Antigua and introduce central factories. The results of the working of the Antigua factories are being closely watched.

Owing, however, to the fact that the cultivation of the cane is carried on more cheaply in St. Kitts than in Antigua, due to the former having a sandy and easily worked soil, coupled with the fact that it also has a larger rainfall, there has been less effort in that island to introduce modern sugar-making machinery. Excepting one small factory. which has a vacuum pan but no triples, the muscovado process is the usual one followed. But the attention of estate owners seems now to be centred on the question of introducing modern methods of sugar manufacture. Along this line appears to lie the course of development in the immediate future.

IMPERIAL QUESTIONS IN THE WEST INDIES.

On March 6th last, Sir Nevile Lubbock, K.C.M.G., gave an address at a meeting of the Colonial Section of the Society of Arts, on Imperial Questions in the West Indies. The chair was taken by Lord Strathcona, and there was a good audience.

The chairman, in introducing the speaker, pointed out their indebtedness to Sir Nevile for introducing the central factory system into the West Indies, and cane farming into Trinidad.

Sir Nevile Lubbock, in the course of his subsequent address, expressed the opinion that, having regard to the importance of some of their colonies and their geographical situation, it was out of question having one Government for them all. A legislative body sitting in Jamaica could never satisfy the people of Barbados or Trinidad, or *vice versa*. And representatives from the various colonies could not afford to spend a large amount of their time annually in Jamaica; West Indians were not a large leisured class. The question of having separate legislatures and one Governor-General might be feasible, but would involve a large outlay. The Governor-General would have to be an exceptional man, consequently his position would carry a high salary. £10,000 or £12,000 would not be an excessive estimate of the yearly cost of maintaining him and his staff.

Sir Nevile, however, thought something might be done towards federation by a gradual assimilation of the laws of the various colonies, and by assembling, from time to time, delegates from all the colonies to confer together on subjects of general interest, such as postal reforms, quarantine arrangements, exhibitions, and possibly even tariffs. He instanced, as a step in this direction, the annual meetings for agriculturists held under the presidency of Sir Daniel Morris, which resulted in much good. It would, however, be agreed that federation was a question which could not be hurried on.

Treating on the question of federation with Canada, he thought the difficulties to be surmounted here were on a par with those relating to federation among themselves. It had been suggested that federation with Canada would merely imply that the latter would take the place of the Colonial Office at home; but, if so, it would be advisable to show that the change would be advantageous to the West Indies, and at present he failed to see where the advantage would come in. The preferential treatment of West Indian sugar might be cited as a case in point, but as a matter of fact the bulk of this preference was at present being intercepted by the Canadian sugar refiners.

As regards the relation of the West Indies to the United States, the latter had been a good customer for the former's sugar; but the future would not hold out such prospects for them, as the U.S.A. gave so much protection to her own sugar interests in Louisiana, Hawaii, Porto Rico, Cuba, and the Philippines, that the demand for British West Indian sugar might conceivably cease altogether in the course of a few years. In the matter of fruit cultivation, too, the Americans would dispense ere long with West Indian supplies; but cocoa still found a large market in the U.S.A., and the time was not yet ripe for dispensing with so profitable a customer,

Canada, on the other hand, was bound to increase her demand for West Indian sugar, and might eventually be able to take the whole production if necessary.

"In conclusion," said Sir Nevile Lubbock, "it is gratifying to feel that the great bar to the prosperity of the West Indies, that is to say, the sugar bounties on the Continent, has now ceased, and I have no doubt if this state of things continues that the future history of the West Indies will be of a more satisfactory character than that of the past. We cannot reasonably expect that any prosperity which may be in store for them should be of rapid growth; it is bound to take time. It must be remembered that the removal of the sugar bounties has not given them any artificial advantage whatever in their competition; it has merely removed what was an artificial disadvantage to them and others. They are still, and will continue to be, exposed to the severest competition, a competition which is aggravated by the fact that the United States, the largest sugar-consuming country in the world, continues to give very considerable artificial advantages to its own producers, including those of Puerto Rico and Hawaii, and also favoured treatment to those of Cuba and Manilla. It may be reasonably expected, however, in view of the plucky manner in which they have fought a one-sided battle for the last thirty years, that the West Indies will give a satisfactory account of themselves in the future, and continue to be a creditable portion of that British Empire of which they are some of its earliest Colonial possessions."*

A recent attempt to smuggle in saccharine from the Continent through Dover was detected: the Customs authorities took the contraband out to sea and poured it overboard. Its value was nearly £700.

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* Quoted from the *West India Committee's Circular.*

THE COLONIAL POLICY OF THE UNIONISTS.

The *West India Committee's Circular* says:—

Now that the long term of office of the Unionist Government has drawn to a close, it may not be amiss to review what has been done for the West Indies since it was returned to power in 1895. In doing this we wish to impress upon our readers the absolute non-party attitude of the West India Committee. In politics we are Imperial, and our special object is to further the general welfare of the West Indian portion of our Empire irrespective of race, religion, or conflicting local interests, and any Government with a true Imperial policy, be it Liberal or Conservative, Radical or Unionist, will receive our loyal support. Now sugar has been, is, and always will be so long as it gets fair play, the dominant industry of these Colonies, and although it can no longer be said, as was stated on one occasion in 1731, that "the least sugar island we have is of ten times more consequence than all Rhode Island and New England put together," still this industry, from its suitability to the fully tropical conditions of the West Indies, forms an important item in the nutrition of the Mother Country. It will, therefore, be generally admitted that by far the most important service which the late Government rendered to the West Indies was the pressure brought to bear at the Brussels Conference which re-assembled in 1901, the meetings of 1898 having proved abortive. Prior to the abolition of the bounties, in response to urgent representations from the West Indies as to their distressed condition in consequence of the position of their staple industry, the Government appointed a Royal Commission of Inquiry at the close of 1896. As the direct result of their recommendations the Imperial Department of Agriculture was formed and supported by Imperial funds, improved steamer accommodation was provided between Canada and the West Indies, and an Imperial subsidy of £20,000 per annum was voted towards the establishment of a new line of direct fruit carrying steamers between Jamaica and the Mother Country. With regard to the latter it is a subject for regret that the results have not proved generally satisfactory to Jamaica, who themselves contribute £20,000 a year to the subsidy, and who complain that the terms of the contract are not being faithfully carried out. In 1898 a severe hurricane swept over the West Indies, and public subscriptions for a Relief Fund were augmented by a Government vote of £40,000 to Barbados and £25,000 to St. Vincent, the islands principally affected, coupled with a loan of £50,000 to each. In the case of the island of St. Vincent, there is no doubt that this timely relief saved the island from industrial extinction. In 1900 a grant-in-aid of £17,000 was voted for the relief of distress caused by a second hurricane which devastated the Leeward Islands in the preceding year. But this was not the end of a series of disasters, for in 1901 the appalling eruption of the Soufrière in St. Vincent called for prompt action on the part of the Government, who were relieved from voting a grant-in-aid by the fact that the various relief funds opened resulted in upwards of £77,474 being subscribed. Unfortunately, the administration of this relief fund gave rise to much adverse, and we fear we must add, justifiable criticism, for now, though nearly four years have elapsed since the visitation, no less than £30,000 collected for this specific occasion remain unspent. We have from time to time called attention to this hanging-up of a fund which if judiciously spent on opening up those districts of the island which were devastated, might prove of considerable industrial benefit to St. Vincent. In 1902, in consequence of the representations of the West India Committee, a sum of £250,000 was voted by Parliament to enable the sugar industry to tide over the period until the Sugar Convention, then ratified, became effective. Again we did not quite see eye-to-eye with the Government as to the distribution of this fund, which was in some cases, admittedly, used for purposes which could not possibly be interpreted as being within its scope, and which, instead of being immediate, extended over a period of years. It was quite understood that the £250,000 was to be a free grant, and its diversion to other channels in Barbados was the subject of much correspondence, though its use for the Plantations-in-Aid Act has proved beneficial, and the fund has now been ear-marked for the sugar industry. In legislative matters, perhaps Jamaica is the only island where there has been any serious difference of opinion with the Home Government, the political situation in that island having been from time to time a source of some controversy; but there has also been a genuine endeavour on the part of the Government to produce uniformity and cohesion among these islands, which the Imperial Department of Agriculture and such an enactment as the Quarantine Ordinance have gone far towards bringing about. We have now dealt briefly with the attitude of the late Government towards our West Indian possessions. On the whole the list of what they have done denotes a practical Government interest for the benefit of the internal affairs of the Colonies. They have encouraged immigration, for the inauguration of which no particular political party can, however, be said to be responsible, as the matter of coolie immigration has received the sanction of successive Governments. But there are sins of omission as well as commission, and as regards the former we must remind our readers that in spite of the constant representations from the West India Committee, as representing the West Indian distiller, the rum surtax, based on calculations which are so manifestly unjust, and so evidently a protection to the home distiller, as not to admit even of argument, remains as heretofore. On the whole, however, so far as local industries are concerned, the late Government contributed to the good of the West Indies to an extent which probably few at home realize. It is not too much to say that, but for their timely action as regards the sugar bounties, these Colonies, or those of them which for special reasons depend upon sugar, would by this time have been dragging out a lingering existence of hopeless bankruptcy. From the point of view, however, of Imperial diplomacy, it must be admitted that their West Indian policy has not been satisfactory. The *Morning Post* of January 16th contains an article on this point, in which much which we have often said in the *Circular* is endorsed. The writer ably portrays the manner in which British interests of late in that part of the world have been gradually allowed to slide, politically and commercially, and draws a graphic picture of the contrast between the growth of American interests and the decline of British. Troops are being withdrawn and the naval strength reduced to a minimum, while British rights under past treaties with United States have been given up without an equivalent being obtained. The commercial policy which Mr. Chamberlain did his best to inaugurate towards these possessions ceased with his departure from the Cabinet. Since then a *laissez aller* policy has been adopted, which if accepted by the new Government can only result, one way or another, in these Colonies, once "the main source of England's maritime and commercial power," being lost to the Empire. It is impossible to overstate the gravity of the situation. Indifference is fatal to loyalty, and it is not surprising to find loyal colonists regarding the situation with apprehension.

METHODS OF ANALYSIS ADOPTED BY THE HAWAIIAN SUGAR CHEMISTS' ASSOCIATION.

The Methods of Analysis adopted by the Hawaiian Sugar Chemists' Association in October, 1903, came up for revision last November. As the methods originally adopted have already appeared in this Journal (Vol. V., April, 1904, p. 172), we do not propose to reproduce them, but will confine ourselves to giving the most important of the few alterations effected.

BAGASSE.

Sucrose in Bagasse: Soluble solids are found by the formula—

$$\frac{\text{Sucrose \% Bagasse} \times 100}{\text{Purity of Residual Juice}}$$

Moisture: Found by drying to constant weight at 100° C.

Fibre: Found indirectly according to the formula—

$$100 - (\text{Moisture} + \text{Soluble solids} - \text{Fibre contained in mixed juice}).$$

EXTRACTION.

The term extraction is used to indicate that percentage of the sucrose in the cane, which is obtained in the mixed juice, expressed by the formula—

$$\frac{\text{Sucrose \% Mixed Juice} \times \text{lbs. Mixed Juice}}{\text{Sucrose \% Cane} \times \text{lbs. Cane}}$$

When the term extraction is used in any other sense, it should be so defined.

Where accurate weights are not available, the extraction may be calculated according to the following formulæ—

$$\text{Bagasse \% Cane} = \frac{\text{Fibre \% Cane} \times 100}{\text{Fibre \% Bagasse}}$$

$$\text{Sucrose in Bagasse \% Cane} = \frac{\text{Bagasse \% Cane} \times \text{Sucrose \% Bagasse}}{100}$$

$$\text{Extraction \% Cane} = \text{Sucrose \% Cane} - \text{Sucrose in Bagasse \% Cane}$$

$$\text{Extraction \% Sucrose in Cane} = \frac{\text{Extraction \% Cane} \times 100}{\text{Sucrose \% Cane}}$$

EXAMPLE.

Available data—

1st Mill Juice = Brix .. .. 20·00
Mixed Juice = Brix.. .. .. 17·00
Sucrose % .. .. 15·30
Purity .. .. 90·0
Residual Juice = Purity.. 75
Extraction = Approximately 93
Cane = Fibre % .. .. 12·5
Bagasse = Sucrose % .. .. 4·30
Moisture .. .. 45·0

Coefficient .. .. .. $\dfrac{\text{Brix Mixed Juice}}{\text{Brix 1st Mill Juice}}$ .. = 99·0

Normal Juice—

Brix.. .. .. = $\dfrac{20{\cdot}00 \times 99{\cdot}0}{100}$ .. .... = 19·80

Purity .. .. = $\dfrac{(93 \times 90) + (7 \times 75)}{100}$ .. = 88·95

Sucrose %.. .. .... = $\dfrac{19{\cdot}80 \times 88{\cdot}95}{100}$ .. .... = 17·61

Cane—

Sucrose % .. .. .. = $\dfrac{17{\cdot}61 \times (100 - 12{\cdot}5)}{100}$ .. = 15·41

Bagasse—

Soluble Solids % .... = $\dfrac{4{\cdot}30 \times 100}{75}$ .. .. = 5·73

Fibre % .. .. .. = 100 — (45·0 + 5·73) .. = 49·27

% Cane .. .. = $\dfrac{12{\cdot}5 \times 100}{49{\cdot}27}$ .. . . = 25·37

Sucrose in Bagasse % Cane = $\dfrac{25{\cdot}37 \times 4{\cdot}30}{100}$ .. . .. = 1·09

Extraction % Cane .... = 15·41 — 1·09 .. .... = 14·32

Extraction % Sucr. in Cane = $\dfrac{14{\cdot}32 \times 100}{15{\cdot}41}$ .. .. .. = 92·03

THE SUGAR INDUSTRY IN JAMAICA.

The following notes were written for *Jamaica in 1905* by Dr. H. H. Cousins, M.A.. D.Sc., F.C.S., Government Analytical and Agricultural Chemist:—

Formerly the chief source of the wealth and exporting capacity of Jamaica, sugar has latterly fallen to a secondary position, and now represents but a quarter of the value of the fruit exported from the island. Even adding the rum, for which Jamaica rightfully holds the reputation of producing the best in the world, the total value of the sugar cane products exported during the past five years is little more than one-third that of the bananas and oranges shipped to the United States.

The causes of this depression of the sugar industry are not far to seek, and in so much as they are of local origin the writer has no hesitation in affirming that they are entirely remediable. The cane grown in Jamaica to-day probably contains nearly the same percentage of sugar as the cane first brought from Otaheite by Captain Bligh in 1796. Its content of sugar is quite ten per cent. below that of the improved sugar-beets grown in Germany at the present time. There are many estates in the island producing from 12 to 15 tons of canes per acre, or the equivalent of an ordinary crop of sugar beet. Instead of a recovery of a ton of sugar from eight or nine tons of produce, as in a modern sugar factory, no estate in the island works less than 11 tons, and the average is fully 16 to 18 tons of cane per ton of sugar. The writer knows of an estate where 27 tons of cane are required to produce one ton of sugar.

The yield of sugar per acre on estates at present in cultivation in Jamaica can be *doubled* by the most ordinary methods and appliances. This statement is not lightly made and it errs rather in underestimation than over-estimation of the problem. Some of the most obvious of these improvements are the following:—

IMPROVED CANES.

The original expectation that the sugar cane might be as greatly improved in sugar content as the sugar beet, by years of systematic selection of seedlings, on analysis, has not been fulfilled. Beyond a certain point—24 per cent. sucrose in the juice—any increase in richness of cane involves a reduction in agricultural yield. The line of development of the sugar cane as a cultivated plant, lies primarily in the direction of increased tonnage of cane, and secondly, in that of greater purity of juice. Systematic work in the improvement of the cane has been carried on for some years in Demerara and Barbados.

The best of these seedlings have been tested in Jamaica, and two stand out in a prominent manner. Barbados seedling No. 208 appears well suited to all parts of Jamaica, and is probably the best cane now available. At the Hope Experiment Station in 1905, a crop of this variety was harvested, yielding over 70 tons of cane, capable of yielding seven tons of sugar per acre. Upon light soils in seasonable or irrigable districts, Demerara seedling No. 95 has proved a great success. This cane has given double the yield of crystallized sugar per acre, as compared with the Jamaica cane, and upon a commercial scale under these conditions.

Seedling canes are being raised and systematically tested on a large number of estates in Jamaica, and practical results are already apparent.

DRAINAGE.

Large stretches of the most unctuous loam ever blended in an alluvial plain are available for sugar cultivation in certain districts of the island. In the past, failure has attended sugar cultivation on certain of these lands owing to an entire failure to appreciate the vital necessity of deep and thorough drainage. With a tropical rainfall this is far more essential than in a temperate clime.

CULTIVATION.

What cultivation can do in improving the growth and production of cane has been well illustrated by the results of a few progressive sugar planters. Deep ploughing, subsoiling, green manuring with cow peas, frequent harrowing, and cultivation are practices vital to the success of cane cultivation on most Jamaica soils. There are estates where good cultivation alone has turned a moribund property into a source of splendid profit to its owners.

MANURING.

At least ten times the amount of fertilizers at present applied to cane land in Jamaica is demanded in the interest of the industry. It is granted that, on lands where cultivation is neglected and the proprietor is satisfied with the minimum crop, which an untilled and uncared-for soil is capable of producing, the use of fertilizers might result in very little financial profit. On well-tilled soils, where sugar cane is not merely grown but cultivated, such fertilizers as basic slag or acid phosphate of nitrogenous manures could be extensively used and a remunerative increase obtained.

A proprietor recently told the writer that the use of fertilizers during the past two years has encouraged him to continue his property as a sugar estate and to secure a profit, whereas, before, he made serious losses owing to the low yield of cane.

A series of experimental plots to test the profitable manuring of the sugar cane is being undertaken by the Board of Agriculture in all the chief sugar districts, and results applicable to each locality will soon be available to guide the planters as to the judicious use of fertilisers.

CENTRAL FACTORIES.

There are perhaps four sites in Jamaica at the present time where the erection of central factories, fed from a clientèle of contiguous estates, would enable sugar to be produced at a greatly reduced cost, but, on the whole, the majority of sugar estates in Jamaica are of sufficient size, agriculturally, to stand on their own merits and to be capable of individual development.

DEFECTIVE CRUSHING.

Nothing so strikes a stranger, when first inspecting sugar estates in Jamaica, as the enormous waste that results from the use of the many old and inefficient mills still at work in expressing the juice from the cane. The writer has seen mills that certainly resulted in a loss of 10, 15, and 20 per cent., as compared with a good single-crushing mill of modern design. On one estate, it has been shown that a mill costing £600 would express over £3000 worth of sugar and rum-producing material per annum. It is pleasing to be able to say that the new mill has been already ordered. On large estates double crushing is a most effective process, but on small estates it is probably better policy to have one really good and powerful mill than a pair of ordinary mills. The five-roller mill, in which the cane is broken up by a preliminary crushing before passing to the three-rollers, has proved a great success and is well suited to Jamaica conditions.

The whole of the plant in the majority of Jamaica sugar works could well be replaced by new and improved fittings and utensils.

For the prospective trade with the mother country, the introduction of vacuum pans is a highly desirable step to take.

RUM.

Given efficient crushing, Jamaica has a splendid advantage in the value of rum as a means of recovering losses in the manufacture of sugar. Although some estates only recover about 60 per cent. of the sugar in the cane juice as commercial sugar, the yield of rum from the residue may bring up the actual output to a relatively high degree of efficiency as compared with a factory where sugar alone is made.

The writer has ascertained by analysis and careful practical experiments that 14 lb. of sugar (including glucose and inverted sugar) will yield a gallon of rum at 40 over proof under good management. If 160 gallons of rum are worth more to the estate than a ton of sugar, it is obvious that an efficient sugar process is not to the interest of the estate. Jamaica rum is the best in the world, and upon the economic and commercial advantages of this by-product of our sugar industry we can in Jamaica show results that compare with those in any tropical country where the sugar cane is grown. Rum will enable estates of limited size to obtain such an efficiency of output that the sugar industry can be economically and profitably carried on under local conditions.

From a recent tour round sugar estates in Jamaica, it was evident that the industry is just beginning to recover from stagnation. Everywhere a feeling of hope, of confidence, and of progress is springing up.

Jamaica can grow canes at a cost of from 4s. to 5s. 6d. a ton in certain suitable districts. If a ton of sugar can be made from eight or nine tons of cane by modern methods and machinery, it is clear that there must certainly be a future for the sugar industry when it is given the benefit of such advantages.

A grievous injury to the true prosperity of the island has been brought about by the ill-informed croakings of people who have maintained that Jamaica's sugar industry is doomed, and babbled of bananas as a panacea for the financial difficulties. In the writer's opinion a capitalist seeking an outlet for his money in Jamaica could find no investment so safe, certain, and remunerative as a well-situated sugar estate managed on up-to-date lines, and with sufficient capital to work economically.—(*West Indian Bulletin.*)

CONSULAR REPORTS.

GERMANY.

German Trade with India.—Official statistics showing the total exports of sugar to India from Germany in 1904 are not at present available, but it appears from the statistics of the trade of Hamburg that the value of the exports of sugar from Hamburg alone to India amounted in 1904 to £100,356, as against £15,391 in the previous year. Inasmuch as nearly all the German sugar exported to India is shipped from Hamburg, these figures doubtless represent very nearly the total exports from Germany in each of the years mentioned. The considerable increase which took place in the sugar exportations in 1904 was, of course, due to the fact that the countervailing Indian import duties were abolished in December, 1903, and the exportations in 1905 will doubtless exceed those of the year 1904. It should be observed that a considerable amount of Austro-Hungarian sugar is likewise shipped from Hamburg to India, but as it is now obliged to be accompanied by a certificate of origin, it is of course duly entered as Austro-Hungarian sugar on importation to India.

JAVA.

With regard to the new sugar tax, it may be noted that the tax on this commodity had been abandoned in consequence of the very low market prices of the years from 1887 to 1898; and it was the excellent results of the past two years which suggested this as a useful means of raising revenue. The present scheme is not for raising any import duty on the article, but to levy a progressive tax on the profits derived from its sale, such profit to be calculated by deducting the average cost price from the average sale price; in this manner an average gain of 25 c. per picul (of 133 lbs.) will be taxed at ½ c. until, according to the following table, a profit of 4 gulden is charged at 24 c., after which sum every clear profit of 25 c. will be calculated at 1¾ c.:—

Gulden.	Charged at Cents.	Gulden.	Charged at Cents.
¼	½	2¼	9
½	1	2½	10¾
¾	1¾	2¾	12½
1	2½	3	14½
1¼	3½	3¼	16½
1½	4¾	3½	19
1¾	6	3¾	21½
2	7½	4	24

Correspondence.

THE PATENT NAUDET PROCESS FOR EXTRACTING SUGAR FROM THE CANE.

To the Editor of the "International Sugar Journal."

Dear Sir,—As the makers of the above machinery, we think it may interest some of your readers to hear of the progress being made by this new process which is now at work in the Island of Madeira, also in the Islands of Trinidad, Porto Rico and Cuba, in the West Indies. We have just received a few figures regarding the installation we erected last year on "Caroni" Sugar Estate, Trinidad, which no doubt will prove interesting to many of your readers.

This new process was only started for the first time in Trinidad last crop, and is about four times larger than the plant at Madeira, so that this was the first time the process had been installed on a large scale, grinding about 600 tons of cane per day; and naturally, being entirely new to the people, there were many difficulties and drawbacks to be overcome in working the process, which was to be expected, considering the great revolution this process accomplishes in the manufacture of cane sugar. Still, last year the entire crop was taken off by the Naudet Process, and gave a much better result than the previous crop which was done by double crushing mills. This year a number of important improvements have been made, so that the results are even still better. The owner of the estate writes to us as follows:—"The alterations and improvements which you have "made on your Naudet machinery for this crop have been most satis- "factory, and give no trouble at all—in fact, the whole machinery "works like clock-work. The average extraction for two weeks was "95 per cent., and last week, for two days, the extraction was 97·2 "and 97·7 per cent. As to the fuel question, we have six boilers and "only burn coal under one of them; the other five boilers give ample "steam, although the only fuel used is the exhausted megass from "the Naudet battery."

From this it will be seen that this new process extracts at least 97 per cent. of the total sucrose in the cane, so that only 3 per cent. of the sucrose is lost, which is a much higher extraction than any nine-roller mill has ever yet been able to attain. The juice is also much purer, as the canes have only passed through one crushing.

As regards the fuel question, we calculate that the amount of coal used under the one boiler will work out at about 1½ to 2 cwt. of coal per ton of sugar made,—but this is a small matter when the extra sugar recovered is considered. Also the manager of "Caroni" Estate informs us that he is in hopes, before the end of the crop, of working the factory without any additional fuel beyond the megass from the Naudet Process.

Owing to the juice being limed, superheated, and thus sterilised within five or ten minutes after being expressed from the mill, and thereafter enclosed entirely from the atmosphere, there is practically little or no inversion whatsoever. The juice is so thoroughly clarified by the circulation through the megass in the Naudet battery, and so freed from all impurities and gummy matters, that, when evaporated, it becomes a syrup which works very freely in the vacuum pans. Therefore, not only is the extraction of the sucrose almost perfect, but the recovery of actual sugar from the juice is also high.

Another point is the simplicity and easily controlled operations of manufacture, as no clarifiers, subsiders, eliminators, or filter presses are used. The juice from the first mill is immediately limed and heated, passes through the Naudet macerating battery, and, when dark crystals for refining purposes are required, no sulphur is used, but the juice passes on direct from the Naudet battery into the triple effet, and so to the vacuum pans, crystallizers, and centrifugals in the usual manner; when yellow sugar is required the juice must be sulphured; when white sugar is desired, then additional sulphuring and Philippe or other bag filters must be used.

These results amply prove that this process is one which will have serious consideration in the future, and place the new process beyond being called experimental, as this estate in Trinidad is now taking off its second crop by the Naudet Process in a most satisfactory manner.

Yours faithfully,

THE HARVEY ENGINEERING COMPANY, Limited,
Sugar Engineers.

Glasgow,
24th March, 1906.

MONTHLY LIST OF PATENTS.

Communicated by Mr. W. P. THOMPSON, C.E., F.C.S., M.I.M.E., Chartered Patent Agent, 6, Lord Street, Liverpool; and 322, High Holborn, London.

ENGLISH.—APPLICATIONS.

4029. O. J. SEIPERMANN, trading as C. FAUST & Co., and J. H. FAIRWEATHER, London. *Improved process for the manufacture of saccharin.* 19th February, 1906.

4050. O. J. SEIPERMANN, trading as C. FAUST & Co., and J. H. FAIRWEATHER, London. *Improved process for the manufacture of saccharine and saccharine salts.* 19th February, 1906.

ABRIDGMENT.

5663. A. HINZE, of Rositz, Saxe-Altenburg, Germany. *Improvements in apparatus for lixiviating and washing sugar and other substances.* 17th March, 1905. This invention relates to a counter-current lixiviating and washing apparatus comprising a vat, partitions dividing this latter into compartments and perforated alternately, one at the top and the next at the bottom, a worm conveyor mounted in the vat and perforated buckets mounted radially upon the conveyor.

GERMAN.—ABRIDGMENTS.

166259. JULIUS KANTOROWICZ, of Breslau. *A process for making a starch which swells and forms paste or size on the addition of water.* May 3rd, 1905. This process of making starch which swells and forms paste or size under the addition of water, consists in treating starch of any suitable kind with caustic potash or soda lye in a concentrated solution of a potash or soda salt with which starch does not form size.

166514. HERMANN SCHULZE, of Bernburg. *A press for beetroot shreddings, sugar cane and the like.* December 20th, 1902. This press is characterized by having a counter piston projecting almost to the middle of the pressing cylinder and acting in the ordinary way under adjustable hydraulic pressure, being automatically regulated during the movement of the pressure piston by means of a valve or slide distributing gear and a lever mechanism, in such a way that on the desired pressure being attained it emerges from the pressing cylinder for the purpose of ejecting the pressed mass by means of the pressure piston, and after the reversal of the movement has taken place, returns to its initial position.

166626. HERMANN HILLEBRAND, of Werdohl, Westphalia. *A front knife for double-shredding box in beetroot shredding machines.* December 22nd, 1904. (Patent of Addition to Patent No. 144326, of April 2nd, 1901.) The front knife described in the original Patent No. 144326 is modified in this invention by the rear part of the knife carrying the blade being bent in such a way that here the grooves along the top of the blade are countersunk relative to the grooves of the front part of the knife in order to allow of a descent of the beetroots and thereby a better cutting by the blades.

166627. A. WERNICKE MASCHINENBAU-AKTIENGESELLSCHAFT, of Halle-on-Saale. *Apparatus for removing sugar slabs or the like from centrifugal insertions.* November 15th, 1904. This apparatus for removing sugar cakes and the like from the insertions of centrifugals, consists in the combination of a centrifugal insertion forming a closed whole and composed of wedge-shaped fixed partitions and other wedge-shaped partitions which are, however, at their folds somewhat movable downwardly and inwardly, a cover and a bottom, so that the movement of the partitions may be limited by side stops. The insertion further consisting of a revoluble ejecting mechanism provided with a stamp, which mechanism may be inserted in the interior of the centrifugal insertion after the rigid connection of the same has been loosened by the slackening of screw nuts provided on the fixed partitions.

166888. RUDOLF QUAREZ, of Amiens. *A process and apparatus for saturating sugar solutions containing lime.* 11th May, 1904. This process for saturating sugar solutions which contain lime and which solutions are introduced in a finely distributed condition under pressure into the saturation vat, is characterized by the saturation gas being also admitted under pressure into the upper part of a vertically arranged mixing tube in the vat, in the ordinary way carried downwards with the sugar solution in counter current and in this way any gas which has not been entirely utilized is forced to emerge from the mixing pipe together with the liquid and to rise again in the vat containing the mixing tube in counter current to the sugar solution. The apparatus for carrying out this process consists in the saturation mixing pipe in which discs, plates, or the like resistances, which are themselves of known type, are alternately arranged with funnel-shaped contractions corresponding to the varying diameters of the vat in which the pipe is arranged, the said pipe being surrounded by perforated or toothed resistances of known character.

166897. AUGUST NEUMANN, of Berlin. *A vacuum boiling down pan having a funnel-shaped enlarging circulation pipe.* 28th October, 1904. (Patent of Addition to Patent No. 156022 of 6th December, 1903.) This is an improvement on the vacuum boiling down pan covered in the original patent, the telescopically extensible circulation pipes of which are replaced by a circulation pipe of uniform length provided at intervals with inlet apertures, and is characterized by this circulation pipe constantly increasing in diameter upwards, with the object of increasing the compression of the liquid with the increase of the liquid column. A modification of the boiling down pan described in this patent consists in its circulation pipe being composed of separate funnels in such a way that each succeeding one is inserted in the preceding one to a portion of its height on the same axis, the said funnels being of a gradually upwardly increasing width.

167050. MEINARDUS WILHELMUS VERWER, of Sneek, Holland. *Apparatus for obtaining uniformly shaped crystals from solutions, more particularly sugar solutions.* March 18th, 1903. This apparatus consists of a revoluble shaft inside the vat containing the solution, on which shaft crystallizing threads, bars or the like are suitably arranged and this shaft is provided with the object of enabling the position as regards height of the deposited crystals in the solution to be interrupted or suitably periodically altered. In a modification of the apparatus hereinbefore described, a horizontal revoluble shaft is employed, which is provided with arms, on which shaft easily removable insertion pieces provided with threads, bars or the like are arranged.

167331. Dr. H. R. LANGEN, of Cologne-on-Rhine. *Process for obtaining sugar from pressed beetroot shreddings.* November 4th, 1904. (Patent of Addition to Patent No. 164396 of December 30th, 1903.) This is an improvement on the method described in Patent No. 164396 and consists in the sugar juice (drain) employed being neutralized or made slightly acid before being mashed with the pressed residues.

NOTE.—Copies of all published specifications with their drawings in these lists can be obtained from W. P. Thompson & Co., 6, Lord Street, Liverpool, at One Shilling a copy for English or American Patents, and Two Shillings for German. In ordering please give number and date.

Patentees of Inventions connected with the production, manufacture and refining of sugar will find *The International Sugar Journal* the best medium for their advertisements.

The International Sugar Journal has a wide circulation among planters and manufacturers in all sugar-producing countries, as well as among refiners, merchants, commission agents, and brokers, interested in the trade, at home and abroad.

The duty on all kinds of sugar imported into Brazil from countries which do not give bounties has been reduced by decree to 200 reis per kg. (4s. 3d. per cwt.)

The new Australian excise tariff provides that the excise duty on sugar shall be increased from 3s. to 4s. per cwt. of manufactured sugar from January 1st, 1907.

IMPORTS AND EXPORTS OF SUGAR (UNITED KINGDOM)

To end of February, 1905 and 1906.

IMPORTS.

Raw Sugars.	Quantities. 1905. Cwts.	Quantities. 1906. Cwts.	Values. 1905. £	Values. 1906. £
Germany	502,306	1,442,716	369,448	608,124
Holland	65,345	29,565	48,437	11,110
Belgium	201,697	134,876	153,404	55,647
France	10,968	123,847	8,200	53,378
Austria-Hungary	114,490	87,415	83,892	37,880
Java	653,408	89,356	495,438	41,451
Philippine Islands	....	....	....	....
Cuba	....	111,910	....	41,943
Peru	273,829	126,620	206,652	61,643
Brazil	19,085	191,373	13,194	76,439
Argentine Republic	....	....	....	....
Mauritius	47,345	20,861	27,820	8,344
British East Indies	....	....	....	....
Straits Settlements	24,052	13,075	12,330	5,751
Br. W. Indies, Guiana, &c.	223,434	227,333	194,158	132,330
Other Countries	154,768	12,691	116,828	6,190
Total Raw Sugars	2,290,727	2,611,638	1,729,801	1,140,230
Refined Sugars.				
Germany	1,514,689	1,666,928	1,301,548	954,559
Holland	279,552	384,896	246,759	232,646
Belgium	65,738	46,850	57,359	28,030
France	125,662	414,118	112,579	226,17
Other Countries	39,952	270	34,847	15
Total Refined Sugars	2,025,593	2,513,062	1,753,092	1,441,561
Molasses	248,603	357,119	64,742	76,254
Total Imports	4,564,923	5,481,819	3,547,635	2,658,045

EXPORTS.

British Refined Sugars.	Cwts.	Cwts.	£	£
Sweden	50	111	48	103
Norway	4,718	2,672	4,041	1,648
Denmark	14,432	15,670	11,786	8,005
Holland	12,493	14,258	10,823	8,210
Belgium	863	1,327	676	723
Portugal, Azores, &c.	2,728	7,158	2,173	3,929
Italy	....	7,926	....	4,262
Other Countries	30,661	91,221	29,409	58,781
	65,945	140,343	58,956	85,661
Foreign & Colonial Sugars.				
Refined and Candy	3,057	2,188	3,002	1,585
Unrefined	8,511	23,878	7,068	12,045
Molasses	190	2,767	81	808
Total Exports	77,703	169,176	69,107	100,099

UNITED STATES.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1906. Tons.	1905. Tons.
Total Receipts Jan. 1st to March 15th	350,317	435,243
Receipts of Refined ,, ,,	225	100
Deliveries ,, ,,	355,297	431,610
Consumption (4 Ports, Exports deducted) since January 1st	308,615	318,250
Importers' Stocks March 14th	33,553	3,033
Total Stocks, March 21st	228,000	216,670
Stocks in Cuba, ,,	207,000	252,000
	1905.	1904.
Total Consumption for twelve months	2,632,216	2,767,162

CUBA.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1905 AND 1906.

(Tons of 2,240lbs.)	1905. Tons.	1906. Tons.
Exports	291,652	206,063
Stocks	239,392	138,828
	531,044	344,891
Local Consumption (two months)	8,150	7,970
	539,194	352,861
Stock on 1st January (old crop)	—	19,450
Total Production	539,194	333,411

Havana, February 28th, 1906.

J. GUMA.—F. MEJER.

UNITED KINGDOM.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION FOR TWO MONTHS ENDING FEBRUARY 28TH.

	IMPORTS.			EXPORTS (Foreign).		
SUGAR.	1904. Tons.	1905. Tons.	1906. Tons.	1904. Tons.	1905. Tons.	1906. Tons.
Refined	110,750	101,279	125,653	175	153	109
Raw	110,626	114,536	130,582	541	425	1,194
Molasses	11,858	12,430	17,856	1	10	138
Total	233,234	228,245	274,091	717	588	1,441

	HOME CONSUMPTION.		
	1904. Tons.	1905. Tons.	1906. Tons.
Refined	121,834	101,648	120,224
Refined (in Bond) in the United Kingdom	77,425	80,176	91,213
Raw	18,423	13,977	20,317
Molasses	14,377	16,781	17,834
Molasses, manufactured (in Bond) in U.K.	10,377	9,523	10,930
Total	242,438	222,105	260,518
Less Exports of British Refined	3,823	3,297	7,017
Total Home Consumption of Sugar	238,613	218,808	253,501

STOCKS OF SUGAR IN EUROPE AT UNEVEN DATES, MARCH 1ST TO 17TH, COMPARED WITH PREVIOUS YEARS.

IN THOUSANDS OF TONS, TO THE NEAREST THOUSAND.

Great Britain.	Germany including Hamburg.	France.	Austria.	Holland and Belgium.	TOTAL 1906.
140	1520	774	760	300	3495

	1905.	1904.	1903.	1902.
Totals	2367 ..	3200 ..	3031 ..	3181

TWELVE MONTHS' CONSUMPTION OF SUGAR IN EUROPE FOR THREE YEARS, ENDING FEBRUARY 28TH, IN THOUSANDS OF TONS.

(Licht's Circular.)

Great Britain.	Germany.	France.	Austria.	Holland, Belgium, &c.	Total 1905-06.	Total 1904-05.	Total 1903-04.
1622	954	602	488	173	3864	4163	3846

ESTIMATED CROP OF BEETROOT SUGAR ON THE CONTINENT OF EUROPE FOR THE CURRENT CAMPAIGN, COMPARED WITH THE ACTUAL CROP OF THE THREE PREVIOUS CAMPAIGNS.

(From Licht's Monthly Circular.)

	1905-1906. Tons.	1904-1905. Tons.	1903-1904. Tons.	1902-1903. Tons.
Germany	2,425,000 ..	1,598,164 ..	1,927,681 ..	1,762,461
Austria	1,510,000 ..	889,373 ..	1,167,959 ..	1,057,692
France	1,085,000 ..	622,422 ..	804,308 ..	833,210
Russia	1,000,000 ..	953,626 ..	1,206,907 ..	1,256,311
Belgium	330,000 ..	176,466 ..	209,811 ..	224,090
Holland	210,000 ..	136,551 ..	123,551 ..	102,411
Other Countries .	410,000 ..	332,098 ..	441,116 ..	325,082
	6,970,000	4,708,758	5,881,333	5,561,257

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All Advertisements to be sent *direct*.

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☞ The Editor is not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

NOTES AND COMMENTS.

The 1906 Budget.

The first Budget of the Liberal Ministry is generally considered a humdrum affair. The Chancellor of the Exchequer (Mr. Asquith) had a small surplus to deal with, but not sufficient to warrant any appreciable reduction in the system of general taxation. The repeal of the coal tax, and the reduction of the tea tax by one penny, exhausts most of his balance, and neither the income tax payer nor the sugar user gets any benefit. We agree, on the whole, that tea had more claim for consideration than had sugar; but since Mr. Asquith expressed his inability to look on the sugar tax as a suitable means of broadening the basis of taxation, we must conclude that it is not so much that he had not the will but rather not the means to warrant its repeal. So it will remain in force for another year at least.

One small reform the Budget brings will, however, be welcomed. It will partake of a reduction in the inland parcel post charges, whereby parcels of 6 lbs. and upwards will go at a cheaper rate than has hitherto been the case. We hope the day will not be far distant when parcels going abroad, to the Colonies at least, will obtain some remission of the present high rates, which certainly seem excessive in the case of heavy articles of small value.

Progress in Antigua.

In this number will be found the first balance sheet of the new Antigua central factory. We think it will prove of sufficient interest and profit to our readers as to warrant its reproduction in full. It is very satisfactory to note that the balance though not large is nevertheless on the right side; considering the unpredecented drought which greatly curtailed the size of the crop, it would not have been surprising had there been a loss for the year. But losses, however satisfactorily they can be accounted for, are always depressing, and the directors of this new concern are to be congratulated on being able to enter on their second year with a credit balance. We hope that the new crop will attain much more to the capacity of the factory than did the old one, as in that case we shall secure more accurate data for gauging the capabilities of an up-to-date central factory. While on this topic, we may note with satisfaction that the Home Government have admitted through their mouthpiece, Mr. Winston Churchill, that the West Indies *have* benefitted by the Convention; and we must not allow them to forget this admission. It may be said that the chief benefit so far has only been one of security. Even granting this, is not security the very foundation of successful business? That such is the case is proved by the very numerous orders for up-to-date plant which have issued from the West Indies and elsewhere, since the Convention was signed.

A German View.

Elsewhere we give a translation of some of the remarks made by our German contemporary, the *Deutsche Zuckerindustrie*, on the opposition raised in this country to the Brussels Convention. The *D.Z.I.*, in effect, vindicates the argument reiterated by us and by all friends of the Convention, that the only fair method of comparison lies in taking periods of several years; the pitting of one single year against any other is opposed to all principles of scientific judgment. But the anti-conventionists have to select such years as will support their *a priori* arguments, and longer periods would presumably not suit their requirements. So we find even the President of the Board of Trade descending to these tactics, as an inspection of his speech in the recent House of Commons debate will show. It may be said that to take 17 years before the Convention and compare it with three after is no fairer. But we have no more than three available, and if they do not suffice for our Radical critics, then why in the name of commonsense cannot they let the Convention have a fair run before denouncing it? When it has been in existence for five or ten years, then they will be in possession of incontestable data to vindicate or to condemn the measure.

Sugar Legislation in Germany.

The Reichstag in its sitting of April 4th last adopted the following resolutions:—

1. That a Bill be introduced during the present session to obtain a reduction in the excise duties from 14 mks. to 10 mks. per 100 kg.
2. That the German Government in the course of its negotiations for a commercial treaty with the United States shall endeavour to obtain for German sugar entering the American market the same equitable treatment as is given to Cuban sugar and to cane sugar in general.

The first resolution is a praiseworthy one, and if passed into law should result in a desirable increase in sugar consumption in Germany. As to the second, we fancy the United States will not be in a hurry to place foreign States on the same footing as their own dependencies.

"Glutose" or "Gallisin."

In Noël Deerr's paper, "On the Estimation of Sugar, Dextrose, and Levulose in Cane Sugar Products," which appeared in our March issue, the author remarked (p. 154) that "Pellet and Meunier . . . . found 20% mannose and 2·40% 'glutose.' This last term is unfamiliar and I take it is synonymous with the term 'gallisin.'" On this point M. Pellet, however, writes to us as follows: "The term 'glutose' being unknown to him (Deerr) he takes as synonymous the word 'gallisin,' which is correspondingly unknown to us in France. The word 'glutose' designates a *ceto-hexose* discovered by MM. Lobey de Bruyn and E. von Eckenstein and so named by them. It is likewise the scientific term adopted by M. Maquenne in his book 'Les Sucres' and by Dr. Lippmann in the last edition (1904) of his great work, 'Chemie der Zuckerarten,' where a whole page (I. 964) is devoted to this hexose." We are much indebted to M. Pellet for clearing up this ambiguity of nomenclature.

"Redo."

"Redo," a form of calcium hydrosulphite, has recently been adopted as a reducing agent for decolourizing juices, increasing the quotient of purity, and reducing the viscosity of syrups. It is soluble in water to the extent of 3-4 grams per litre and the solution has a neutral or slightly alkaline reaction. In refining practice "redo" is added to the melted syrup after defecation with lime; the temperature is then raised to 8°C and the syrup is filtered. The action of the hydrosulphite is given by the equation $CaS_2O_4 + Ca\,(OH)_2 = 2CaSO_3 + H_2$.

Owing to the regretted indisposition of Mr. T. H. P. Heriot, we are unable this month to insert the continuation of his serial on "Simple Methods of Chemical Control." We hope, however, that he will soon be well enough to complete his interesting and valuable series of papers.

SUGAR IN PARLIAMENT.

FICTION; AND SOME FACT.

A little debate on the Sugar Convention, on 27th March, ended in a fiasco. There were seven fiction speeches; quite overweighted by the brief but conclusive facts stated with the utmost clearness and good sense by Mr. Mitchell-Thomson, who will evidently be a tower of strength to the sugar industries in the House of Commons. He was well backed up by Lord Percy and Mr. Chamberlain, and was complimented even by the fiction party.

The performance somewhat resembled a renovated variety entertainment brought up to date, with many of the old scenes and dances but some of the dresses and topical allusions quite new. The revival was not well received and the manager was obliged to apologise and drop the curtain.

We will glance briefly at some of the amazing statements that go down so successfully with "the general reader." Here is one which we have heard from wiser lips a long time ago; and yet, strange to say, it is an absolute fallacy.

> The foreign refiners and producers, in their desire to secure the English market, had entered into a policy of such senseless competition that they had brought the price of sugar in England down to 6s. a cwt. Supposing that insane policy had been continued, and we had had sugar brought into this country for nothing, would that or would it not have been a benefit to this country?

Mr. Leonard Courtney asked the same question in 1879, as a Member of the Select Committee on Sugar Industries, and the witness promptly replied that if that could be guaranteed as a permanent arrangement we might smoke cigars all day and do nothing. But as it must inevitably result in the destruction of all natural competition, and even in the ruin of all bounty-fed producers except those who received the largest bounty, it was evidently a disastrous arrangement from the consumer's point of view. But even with a price of 6s. per cwt., which is more than 3s. below the cost of production, the same result must be inevitable if such a price were maintained; and it is well known in the sugar markets of the world that another year or two of those prices would have left the world dependent for its ten million tons of sugar entirely on Germany and Austria. It is also well known that the German industry at that time, 1901-2, definitely adopted the policy of over-production in order to keep prices down and stop all competition. They knew that if they were successful not only cane sugar would go to the wall but also their more formidable competitors in France and other bounty-fed countries.

There are two minor fallacies in the quotation. The Continental producers, as we have just shown, were not competing especially for "the English market." They had a much wider *clientèle* than that, and one which would have grown enormously if the price of 6s. per cwt. had continued. But what the speaker wanted his hearers to believe was that this low price was a special benefit enjoyed by England alone. It was, in his words, "the price of sugar in England" that went down. For more than thirty years the fiction party have actually believed—even eminent Government officials—that there were two prices for sugar, the "cheap bounty-fed price" in England, and the "dear West India sugar" price for the rest of the world. They do not know that our price is always the world's price. These are abstruse facts beyond their ken.

Let us pick out another plum.

> No sooner did the Brussels Convention become law than the price of sugar went down in all producing countries and up in England.

Here we have positive proof that the speaker did not know the elementary fact that our price is always the world's price. The consumers in Germany and France got their sugar cheaper because the duty was reduced; and the duty was reduced because the Government no longer had to meet the expense of the bounty. But the price of *the sugar* was identical in Germany, France and England. The speaker did not wish his hearers to understand that.

He then explained that the present price of sugar is 8s. 4½d. per cwt. He does not add that that is a price below the cost of production but merely declares that "if to-day there had been no Brussels Convention the price of sugar, instead of being 8s. 4½d. per cwt. would be about 5s. 6d. or 5s. 9d." Five years of sugar at 3s. per cwt. below the cost of production does not strike the speaker as anything out of the common. Let us assume that out of the world's consumption of ten million tons per annum the producers of three million tons were able by means of an enormous bounty to produce sugar at 6s. per cwt., free on board Hamburg, without loss; and that the producers of another three million tons only lost 1s. 6d. per cwt.; while the producers of the remaining four million tons lost the whole 3s. per cwt. That would give an annual loss of

	£
3,000,000 tons at 1s. 6d. per cwt.	4,500,000
4,000,000 ,, ,, 3s. per cwt.	12,000,000
Total loss for one year	£16,500,000
Total loss for five years, 1901-6	£82,500,000

The speaker positively believed, as proved by his own words, that if there had been no Sugar Convention he would at the present moment be enjoying sugar at 5s. 9d. per cwt. and that the sugar producers of the world would have cheerfully supplied him with all he wanted at that price, at a cost to themselves—being multi-millionaires—of nearly one hundred millions sterling. All this sounds like great nonsense when put into plain English, but the fiction party tell us that it helped them to get their big majority last January.

Let us take another plum.

> He did not wish to give the House exaggerated figures, but a great authority had stated that in sugar-using industries 50,000 persons had been working half time through the action of the Convention, whilst 12,000 had been added to the number of the unemployed.

The only point in this statement is contained in the words "through the action of the Convention." Without those words the statement may or may not be true—probably not. With them it can be shown in a moment to be false. The statement was first made long before the short crop of 1904-5, but we will prove it to be false whether made then or now. From the low prices of 1901-2, up to July, 1904, the world's price of sugar never reached the cost of production. The average price for the year 1903 was about 1s. per cwt. below the cost of production. The highest price in that year was more than 6d. per cwt. below the cost of production. In 1904 it fell to 1s. 6d. below cost price, and for the first six months of that year the average price, in spite of an unexpected shortage in the Cuba crop, was quite 1s. per cwt. below the cost of production. And yet the public and the House of Commons are asked to believe that in the sugar-using industries, with sugar actually more than 1s. per cwt. *below the cost of production*, large numbers of men were partially or entirely thrown out of employment "through the action of the Convention," by which the speaker means you to understand "through the high price of sugar." Here, then, is falsehood number one. Now let us turn to the subsequent period, long after this assertion first saw the light, when the price of sugar did really go up, not because of the Convention but because of a sudden diminution of more than a million tons in the expected supplies of sugar for the world's consumption, owing to the partial failure of the beetroot crop. What do the "sugar-users" tell us themselves of the state of their industry during this temporary period of dear sugar. We get it in the *Chamber of Commerce Journal* of last November, and Mr. Mitchell-Thomson read it to the House in the course of his conclusive speech:—

> He found that during the eleven months ended November, 1903, 1904, 1905, the quantity and value of the exports of confectionery, jams and preserved fruits was higher last year than in any of its predecessors. The exports were in 1903, 294,886 cwt.;

> in 1904, 289,841 cwt.; and in 1905, 315,478 cwt. The values were in 1903, £743,718; in 1904, £750,870; and in 1905, £824,221. The same Journal said:—"Moreover, what is more satisfactory still, there was no doubt that there was even greater improvement in the home trade."*

Thus we see that the original statement, which was clearly false when sugar was actually so cheap as to be considerably below the cost of production, is equally false now, on the showing of the official report of the very industry which, according to "a great authority," was being ruined when sugar was at half the price. Again we are told that these are "the facts" that procured the great majorities of last January.

The speaker then tries to make his hearers and readers believe that there has been an enormous increase in the importation of foreign confectionery. He gives no figures in proof of this assertion, because figures would not prove it. This is all that he says:—

> In one shop alone, where practically no trade was done in foreign confectionery, a trade had grown up in these few years to such an extent that a large percentage of the trade done in that shop was done in those goods. When he took out those statistics (*sic*) before the election he was able to point out that what was being sold over the one counter was responsible for four British workmen being thrown out of employment.

There are no statistics; but the statement was quite sufficient he found to get him his big majority last January. He concluded by congratulating the House that "a strong Government had been returned whose interest was that of the great mass of the consumers of this country."

He and his strong Government both believe that the true interest of the consumer is that sugar should remain below the cost of production just long enough for all producers to disappear—and with them the sugar they produce.

So far we have dealt only with the speech of the mover of the resolution, and our space forbids any further analysis of the speeches of the Fiction party. Sugar is still well below the cost of production, and yet Mr. Paul does not hesitate to tell us that "this was a mean and cruel Convention, because it pressed hardest on the industrial classes of the community and with real and crushing severity on the poorest of the poor." The German beetroot sugar industry, which can produce cheaper than any other European country, are at this moment crying out because, as they declare, sugar is below cost price. They must be surprised to hear that an eminent member of the British Parliament declares sugar to be so outrageously dear that its price is pressing "with real and crushing severity on the poorest of the poor."

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* The latest Board of Trade return is as follows: Exports of British confectionery, jams and preserved fruits for the three months ending March 31st:—1904, 68,015 cwts.; 1905, 74,898 cwts.; 1906, 90,135 cwts. The imports of foreign, including chocolate, were for the same period of 1906, 16,318 cwts. The *increase* in the exports amounted to more than the *total imports*, which are clearly an absolutely inappreciable faction of the total British production and consumption.

Sir J. Dickson-Poynder goes one better. He says that "Germany was the greatest gainer with an increased consumption of 400,000 tons *at a lower price than ourselves*, whose consumption had been decreased by 300,000 tons, while we paid something like £5,000,000 more for our decreased consumption."

At last we have some figures—such as they are. The Hon. Member must quite regret that he cannot have the opportunity of producing them at another general election. Without the duty, we paid exactly the same, per ton of sugar, as the German consumer; with the duty, we paid, of course, considerably less.

These are not specially selected specimens of the assertions of the fiction party; we have taken them fairly as they came. The further consideration of this debate must be postponed. In spite of the matter being mainly nonsense, it is important that it should be analysed, because the time will come when the Government will have to decide as to its future policy, and therefore it is well to know their case and the extent of its weakness. So far they would appear to have no case, but unfortunately they have discovered that fiction is stronger than fact, and will prevail.

THE AGITATION AGAINST THE CONVENTION.

A German View.

The Deutsche Zuckerindustrie, discussing England's attitude to the Brussels Convention, says that amongst the arguments advanced against the latter, the most important is the question of sugar prices. At first sight it would seem as if the charge were well founded. To quote our contemporary:

"If one compares the present prices for 88% beet in London with those ruling during the two years previous to the Convention, a rise in prices is certainly apparent. Whereas in April, 1902, it was 6s. 6¾d. per cwt. and in April, 1903, 8s. 2¼d., it is now (April, 1906) 8s. 4½d. If with certain qualifications we are entitled to take the years 1902 and 1906 as the ones most nearly corresponding in their conditions, then we have a rise of 2s. to account for. It cannot also be denied that this year the world's price is higher than in the lowest year previous to the Convention. On the other hand, it seems to us a risky thing to conclude that without the Brussels Convention and with a continuation of State and Cartel bounties, we should at present have as low prices as in 1902, or, as is asserted in England, the still lower price of 5s. 6d. or 5s. 9d. At any rate it cannot be altogether assumed that but for the Convention we should now have lower prices than is actually the case. Moreover, it is scarcely satisfactory in reviewing changes of price to select for that purpose two single years, subject as they were to more or less weighty influences. Rather does justice and every scientific method of demonstration insist that longer periods of time be taken. On this hypothesis, we reproduce herewith the prices for the last 20 years. . . The price in London for German 88% beet f.o.b. at the beginning of April was :—

	s.	d.		s.	d.		s.	d.		s.	d.
1906 ..	8	4½	1901 ..	8	11½	1896 ..	12	4½	1891 ..	13	9
1905 ..	14	6½	1900 ..	10	1¼	1895 ..	9	3	1890 ..	11	10½
1904 ..	8	6½	1899 ..	9	11¼	1894 ..	12	6	1889 ..	17	4½
1903 ..	8	2¼	1898 ..	9	1	1893 ..	15	10½	1888 ..	14	0
1902 ..	6	6¾	1897 ..	8	9¾	1892 ..	13	4½	1887 ..	11	4½

"The average price during this 20-year period was hence 11s. 2d., while for the 17 years before the Convention it was 11s. 5d., and during the last three years, or subsequent to the Convention, 10s. 6d. It has also to be observed that the last-named period covers the year 1905 which for a short time exercised an entirely disproportionate influence on prices; since this year was quite an exceptional one, it had far better be omitted. But even allowing the inclusion of the year 1905, we find from the above figures that the mean price after the Convention is considerably lower than the average of 17 years before the Convention, for while the English consumer had to pay on an average 11s. 5d. for ante-Convention sugar, he only pays 10s. 6d. now. But, as above mentioned, it seems fairer to omit the prices of 1905, so that the figures of price before and after the Convention should be 11s. 5d. and 8s. 5d. respectively. It seems, therefore, a questionable thing to persuade the English consumer that the Convention has increased the cost of sugar."

The *D.Z.I.* finally refers to the agitation got up by the sugar users, who allege that as a consequence of the Convention British exports of confectionery have dropped and imports increased; and considers that these statements too should be received with every caution. Our contemporary settles the matter to its satisfaction by quoting the figures from the Board of Trade Returns for confectionery, which dispose effectively of the argument that the exports have dropped. Exports of "confectionery, jams, and preserves" have been as follows :—

	Cwts.		Cwts.
1900	276,248	1903	319,736
1901	309,251	1904	314,879
1902	335,228	1905 .. .	345,376

This does not suggest retrogression. As to the imports, these have only found a place in the Board of Trade Returns since January last; but such as they are, they do not reveal any appreciable increase.

THE POSSIBILITIES OF BRITISH SUGAR MANUFACTURE.

As briefly recorded in our Notes of last month, there was a debate in the House of Lords on April 2nd, on the cultivation of sugar beet in the United Kingdom. The Earl of Denbigh, whose praiseworthy experiments in beet growing on his Newnham Paddock Estate are known to our readers, was responsible for the debate, and in his opening speech made a strong appeal for State support in aid of a British beet sugar industry. He drew attention to the universal cultivation of beet and the immense advantage its adoption had proved to countries like Germany, where in its infancy the industry had had the support of the Government. Now that the Brussels Convention allowed a surtax of 2s. 6d. per cwt. on home grown sugar, he thought the Government might well allow this rebate to enable the new industry to be started. He dwelt on the experiments which had been made in this country to grow beets, experiments which had everywhere been successful, but pointed out that owing to lack of experience, it would be highly improbable that a new factory would be able to pay for some years, and if the Government intended this sugar to pay full duty, the trade might have to wait indefinitely before capital was subscribed to start factories. He suggested the excise should be fixed at 1s. 8d. per cwt., in which case capital would be immediately forthcoming, and a new impetus would be given to agriculture.

Lord Denman, in reply, said they desired to do all that lay in their power to help the farmers and improve the conditions of the agricultural community in general. But as had been pointed out by the late Chancellor of the Exchequer,* the proposal of Lord Denbigh would involve a grave departure from the fiscal policy which had prevailed in this country during the last 60 years, and if the late Government were precluded by their pledges from entertaining it, how much more were the present Government. Fiscal reasons apart, he was, however, afraid that if the proposal were accepted, and an industry started, the latter would depend for its existence on the rebate, and if at a future time the Exchequer proposed to remove this advantage, great distress would be alleged to fall on the persons engaged in this industry. He also wanted to know what the West Indies would think of this subsidy of a home industry competing with them.

Lord Lathom, who has experimented in beetroot growing in Lancashire, appealed to the Board of Agriculture to hold out some hope of assistance to this new industry which he thought might thereby be made profitable, and of immense benefit to those living on the soil.

The Marquess of Lansdowne said this was a subject deserving the serious consideration of the farming community. He could not congratulate the Government on their attitude, though he admitted that the arguments they advanced were entitled to a considerable amount of weight, especially as regards the difficulty of cancelling a rebate once allowed. He thought, however, that there were other forms of encouragement besides that proposed by Lord Denbigh; but the latter had shown that there was a case for doing all that they possibly could to give this new industry every encouragement in its earlier stages.

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*See correspondence at end.

The Marquess of Ripon, speaking for the Government, said there must be no misunderstanding as to their intentions. All experience went to show that when the limited period during which assistance was given came to an end, extreme representations were always made by those engaged in the industries concerned that they would be ruined if the rebate were not continued. This, he thought, was an adequate reason why the Government should not consent to give any special encouragement. He considered, however, that there was good reason for thinking it might be possible to start the industry in this country without artificial aid.

The debate then terminated.

Previous to the debate, the Earl of Denbigh published some correspondence dealing with the possibilities of British sugar manufacture. It was as follows:—

"MEMORANDUM SENT TO THE EARL OF ONSLOW, PRESIDENT OF THE
"BOARD OF AGRICULTURE.

"*March 8th, 1904.*

"The cultivation of beet sugar has been carried on in Great Britain on an experimental scale for some years, and the results of the analyses of the roots have been carefully tabulated and published from time to time by competent and well-known analysts.

"These results have conclusively proved that in almost every part of Great Britain and Ireland, and on varying soils, sugar beet can be grown of a quality, if anything, superior to the best beet grown in the Magdeburg district of Germany, so far as purity and percentage of saccharine contents of the roots are concerned. It is admitted by everyone that, if the cultivation of beet for sugar purposes can be made a success on a commercial scale, it would very soon develop into an important agricultural industry, provide a new and profitable crop for farmers, and be of great benefit to many of our country districts. Hitherto, however, beet has not been grown on a commercial scale, because there was no market for it, and sugar factories have not been erected because no beet was grown, and the existence of the foreign bounty system was sufficient to prevent capitalists from risking their money.

"Owing, however, to the Brussels Convention, there is now a prospect of this important industry being developed, if capitalists can be made to see that Government will give them encouragement, and if they see a reasonable chance of a good return on their investment. The ordinary British agriculturist being, as a rule, of very conservative habits in agriculture, it might take some time to establish a sugar industry, more especially as it is well known that a factory established some forty years ago at Lavenham, had, after running successfully, to be ultimately abandoned owing to the foreign bounties. As great improvements have taken place both in sugar producing methods and machinery, and in the saccharine properties of the roots now grown, there would seem to be no reason why a factory should now be a failure if properly organized and managed, *and if the price of the finished product is sufficiently good to allow of a remunerative price being paid to the growers of the roots.*

"The latter point is practically the crux of the whole situation, for, owing to the way labour has left many of the country districts, there will no doubt be difficulties at first, until it can be conclusively shown to the agricultural population that good wages and a good profit can be obtained by growing sugar beet and selling it to factories for sugar purposes.

"It is therefore of the *very greatest importance that the first effort* to establish this industry should meet with success.

"To make a start it may be necessary to get from £80,000 to £100,000 subscribed or guaranteed, as, to treat the sugar economically, it would be necessary to put up a factory capable of handling from 30,000 to 40,000 tons of beet per annum. Taking the average crop at about 15 tons per acre, this would require from 2000 to 3000 acres under beet annually, and at a convenient distance from the factory.

"This money having been guaranteed, it would be necessary to select a suitable centre, and make definite contracts with surrounding farmers to grow beet for five or ten years, at prices which would be good enough to tempt agriculturists to make this new departure, and then proceed to erect a factory with its necessary accompanying organizations.

"The position therefore is at present as follows:—

"It is claimed that sugar beet can be grown in Great Britain and Ireland of as good a quality as on the Continent.

"It is believed that money to establish an industry would be forthcoming if the prospects of a satisfactory profit were sufficiently good.

"When the sugar import duties were imposed, no power was taken with regard to excise duties, as there was then no sugar produced in this country.

"By the Brussels Convention, in a sugar producing country, the surtax, that is, the difference between the excise and import duties, must not be more than 2s. 6d. per cwt.

"The present import duty being 4s. 2d. per cwt., those who wish to make the experiment of a sugar factory wish to have an assurance that if an excise duty is imposed, it will not, at all events for a term of years, amount to more than 1s. 8d. per cwt., which would make the surtax 2s. 6d. per cwt., the maximum amount allowed by the Convention, thus giving home grown sugar a temporary advantage of 2s. 6d. per cwt. over imported sugar.

"It is submitted that, in consequence of the present low price of sugar, the prospects of profits, if an excise duty of 4s. 2d. is to be charged, are not sufficiently attractive to make it worth anybody's while to start an industry which will very likely have to run at a loss for some time until agriculturists learn how to get the best results in beet growing. It is also admitted that, as there is at present a tax on sugar, the proposal made herein would not be open to the objection that it would raise the price of sugar, for, if successful, the establishment of a home grown sugar industry would tend, if anything, to lower the prices.

"(Signed) DENBIGH."

Being informed that great difficulties stood in the way of any such arrangement as he asked for, Lord Denbigh had an interview soon after with the Chancellor of the Exchequer. About that time the price of sugar began to rise very considerably; so he waited, and finally wrote the following letter, dated November 28th, 1904:—

"My dear Chamberlain,

"Owing to the recent rise in the price of sugar, and the consequent excitement which has been caused, I am anxious to do something further to direct attention to the possibilities of home grown beet sugar, having regard to the successful experiments which have been carried on for several years by various people, myself included.

"You may remember that last session I had a conversation with you as to the possible imposition of an excise duty in the event of sugar being manufactured at home, and you stated to me that, inasmuch as the Government had pledged itself not to depart from, or interfere with, the existing fiscal system of the country prior to a General Election, you would, if sugar manufacture were started, feel compelled to seek legislative powers (which I understand you do not possess now) for enabling you to put on home-made sugar an excise duty equal to the full amount of the present or existing import duty.

"This would of course prevent British home made sugar from having that advantage of 2s. 6d. (about) per cwt. over other sugars which is permitted under the Brussels Convention to the home made sugars of other manufacturing countries. As my conversation with you was a private one, I write to ask whether I have your permission to make the above public, *i.e.*, if I have stated your views correctly, as, in any discussion on the manufacture of sugar, the question of duty is bound to come up.

"The question is one of very great importance, and it is hard to exaggerate the benefits that might accrue to agriculture in certain portions of the country if it were once clearly proved that sugar could be profitably manufactured and agriculturists consequently took to growing the beet. Apart from the advantage to land occupiers of having a new profitable crop, and the advantage to country districts of having an increased demand for labour, experience has shown that the cultivation of sugar beet improves the production of the locality, for, to make sugar beet a success a man must do his land well, and this of course affects the other subsequent crops as well.

"There is, however, a great prejudice against sugar beet in this country, and, owing to some past failures, it is of the greatest importance that the next attempt should succeed. Owing, however, to the necessity for gradually enlightening that somewhat slow moving person, the British agriculturist, it would probably, even if a factory were started, be impossible to get the best results at the outset, and this would appear to be eminently a case where, if a new industry could be financially encouraged for a few years, it might then be firmly placed on its legs and require special favours no longer.

However, I know that, at all events for the present, this cannot be, and of course one Chancellor of the Exchequer cannot bind his successor, but I wish to record my protest against a system which would have the effect of throttling in its infancy a new and valuable industry.

"Sincerely yours,
"(Signed) DENBIGH.
"The Right Hon. Austen Chamberlain, M.P."

The reply to the above letter was as follows:—

"Treasury Chambers,
"Whitehall, S.W.,
"*20th December, 1904.*

"My dear Denbigh,

"I have delayed answering your letter of the 28th ultimo in reference to the growth of sugar beet in this country until I could discuss the matter with the Prime Minister; but I am now in a position to give you a full answer.

"You are aware from our previous conversation, that if beet sugar were largely produced in this country, our International obligations would oblige us to impose such an excise as would reduce the difference between this duty paid by home grown and that paid by imported sugar to the limit fixed by the Brussels Convention; but you ask me whether His Majesty's Government can give you a guarantee that the excise on home-grown sugar shall not exceed what is necessary for this purpose.

"I fear it is not possible for us to give you such an undertaking. I fully appreciate the great advantage to agriculture which would follow the introduction into this country of a new and lucrative industry, whilst the circumstances of the moment show how very desirable it is that the sources of our sugar supply should be extended, and that we should in future be less dependent than we now are upon the continental crops. I can quite understand also that, as you explain, heavy initial capital expenditure is required to start the new industry on a profitable basis, and that, however good the ultimate prospects are, it may be a year or two before the enterprise could show any return to investors. This may indeed be one of the cases in which the natural course of industry would ultimately be helped, not hindered, by aid given in the initial stages of a new manufacture. On this aspect of the question I have not information which would enable me to offer an opinion. But, whatever view we take on this point, it cannot be denied that such a pledge as you ask for would be a great departure from the Fiscal Policy which has prevailed in this country for the last sixty years, and His Majesty's Government are precluded from making such a change during the present Parliament by the pledges which they have given to the country.

"Yours truly,
"(Signed) AUSTEN CHAMBERLAIN.
"The Earl of Denbigh."

Lord Denbigh afterwards decided to do nothing further for the time being, as the prices for sugar were of an abnormally fluctuating nature, and it seemed advisable to wait until the market settled down, and some opinion could be formed of the probable normal price under the new conditions.

It was also quite apparent to him that the late Government were unable to depart from the pledges referred to, and even if they had felt that the grant of temporary concession in the matter of excise was not a violation of such pledges, such temporary concession would have been no inducement to capitalists, as it was common knowledge that a General Election could not be long delayed, and nobody could say how the matter would be regarded by the next Chancellor of the Exchequer.

ON THE "AVAILABLE SUGAR" IN CANE SUGAR JUICES.

By Noël Deerr.

In the *International Sugar Journal*, No. 53, I obtained a formula representing the available sugar in a cane juice. The formula I then obtained can now be more easily deduced on the following argument.

In unit weight of material let there be a sugar and b non-sugar.

Let c sugar be removed, leaving $1 - c$ residue, which contains d sugar per unit weight.

Then $a = c + (1 - c)\,d$, whence $c = \frac{a - d}{1 - d}$ and $\frac{c}{a} = \frac{a - d}{a(1 - d)}$

But $\frac{c}{a}$ is the proportion of sugar that has been extracted, and for a and d on the right hand side of the equation we may put j and m, which are the purities of the juice and molasses respectively.

The equation may then be written—

$$\text{Extraction} = \frac{j - m}{j\,(1 - m)} \qquad (1)$$

and if to m be given an arbitrary value indicative of refuse or exhausted molasses, the formula becomes, putting $m = {\cdot}30$,

$$\text{Available sugar} = \frac{j - {\cdot}30}{j\,(1 - {\cdot}30)}$$

This formula is practically identical with the one used in the control of factories in Java, and which is usually written in the form—

$$\text{Available sugar} = S \times \left(1{\cdot}4 - \frac{{\cdot}4\,B}{S}\right)$$

S being the percentage of sugar in the juice and B the degree Brix or Balling.

The formula (1) above is only correct under certain limitations; it assumes that the sugar extracted is pure sugar and that there are no mechanical losses in manufacture. In Demerara and the English-speaking cane sugar countries generally the term extraction in factory control means the expression—

$$100 \times \frac{\text{gross weight of commercial sugar}}{\text{weight of sugar in juice}}$$

A part of the non-sugar is contained in the commercial sugar and the effect of this will be to make the extraction higher than as indicated by the formula, and it will also tend to give a fictitious higher purity to the molasses. These sources of error may be corrected in the following manner.

Let there be a material containing a sugar and b non-sugar per unit weight. Let c sugar and d non-sugar be removed and let $(c+d)$ contain e sugar per unit weight.

The weight of the residue is $(1-c-d)$; let it contain f sugar per unit weight.

Then
$$a=(c+d)\,e+(1-c-d)\,f$$

whence
$$\frac{c+d}{a}=\frac{a-f}{a\,(e-f)}$$

or
$$\text{Extraction}=\frac{j-m}{j\,(s-m)} \qquad (2)$$

where j and m are as previously and s is the purity of the commercial sugar.

In this form the formula refers to the *dry* commercial product, and when corrected for the water present it appears as—

$$\text{Extraction}=\frac{j-m}{j\,(s-m)}\times\frac{100}{\text{Balling of the sugar.}} \qquad (3)$$

and the total pure sugar capable of recovery is given by the formula—

$$\frac{j-m}{j\,(s-m)}\times\frac{100}{\text{Balling of the sugar}}\times\text{sugar \% in the commercial product,}$$

which may be expressed as $\frac{s\,(j-m)}{j\,(s-m)}$ (4)

The differences that appear when formulae are applied to actual practice may be best illustrated by an example.

Purity of juice $(j)=\cdot80$; purity of exhausted molasses $(m)=\cdot36$. Commercial sugar made was of composition, sugar 96·0; water 1·2; purity (s) ·9718.

Then from formula (1) Extraction $=\frac{\cdot8-\cdot36}{\cdot8\,(1-\cdot36)}=\cdot8594.$

From formula (3) Extraction $=\frac{\cdot8-\cdot36}{\cdot8\,(\cdot9718-\cdot36)}\times\frac{100}{98\cdot8}=\cdot9078.$

From formula (4) Pure sugar $=\frac{\cdot8-\cdot36}{\cdot8\,(\cdot9718-\cdot36)}\times\cdot9718=\cdot8734.$

If in the case quoted the extraction in its usual significance was ·8604 of sugar at 96°, this would indicate an extraction of ·826 of sugar at 100°. Formula (4) shows that corresponding to the observed analyses there should have been obtained ·8734 of sugar at 100, so that the loss in press cake, entrainment, &c., is ·0474, *i.e.*, 4·74% of the sugar in the juice. As regards the applicability of this formulae to actual practice, the losses that occur in the press cake and in entrainment will always prevent the formula in its complete form being realised; in addition there is the error in the determination of the purity of the refuse molasses. Under certain conditions the conventional direct polarimetric assay of a refuse molasses will give results closely approximating to the truth, but to obtain exact agreement with the formula, after allowing for losses in press cake, the Clerget process should be applied, and all other sources of error in the analyses eliminated. As an empirical result I am of opinion that the commercial extraction should not be less than that indicated by the formula in its simplest form $\frac{j - m}{j\ (1 - m)}$, the difference between this result and that obtained from (2) being sufficient to account for all losses in press cake and in entrainment.

If the values of $\frac{j - m}{j\ (1 - m)}$ be calculated it will be seen that as the purity of the juice increases, so also does the available sugar, and that the increase in available sugar is greater for low purities than for higher ones, *e.g.*, with refuse molasses of purity 40 an increase in the purity of the juice from 70 to 80 raises the available sugar from 71·43 to 83·33, an increase of 11·90; for the same purity of refuse molasses an increase in the purity of the juice from 80 to 90 raises the available sugar from 83·33 to 92·60, an increase of 9·30.

Similarly, as the purity of the refuse molasses falls the available sugar increases, and the rise in available sugar is greater as the purity of the molasses is higher. Thus with an initial purity of 80 a fall in the purity of the molasses from 45 to 40 indicates an increase in the extraction from 79·54 to 83·33, a difference of 3·79, a further fall to a purity in refuse molasses of 35 only raising the extraction to 86·54, a rise of 3·21.

In general, for initial purities of the order 80 and final purities of the order 40, each unit of increment in the initial purity corresponds, roughly speaking, to an increase in the available sugar of unity, and each fall of unity in the purity of the refuse molasses corresponds to an increase in the available sugar of ·6.

The formulae deduced above are applicable to any stage of the manufacture, as in the case of a low masse-cuite of purity 50 which on curing gives molasses of 35 purity. Sugar of 88° polarization, 89·8 purity and 98% solids results. Then per unit of sugar in the masse-cuite there results using formula (4)—

$$\frac{\cdot 50 - \cdot 35}{\cdot 50\ (\cdot 898 - \cdot 35)} \times \cdot 898 = \cdot 4911$$

i.e., 49·11% of the sugar in the masse-cuite is recovered.

Using formula (2) the extraction appears as—

$$\frac{\cdot 50 - \cdot 35}{\cdot 50\ (\cdot 898 - \cdot 35)} \times \frac{100}{90} = \cdot 5582$$

i.e., the weight of the commercial product is 55·82% of the sugar in the original masse-cuite.

If the masse-cuite was of 95 Balling the commercial product per cent. by weight on the original masse is $55{\cdot}82 \times {\cdot}50 \times {\cdot}95 = 26{\cdot}51$.

This result can be expressed by the formula—

$$\text{Commercial sugar per cent. on masse-cuite} = \frac{B_m\,(j-m)}{B_s\,(s-m)}$$

where B_m and B_s are the degrees Balling of the masse-cuite and commercial sugar respectively.

In establishing the above formula I have referred the purities to unity instead of to 100 as is usual; the expressions obtained are thus simplified in writing.

THE ANTIGUA CENTRAL FACTORY.

First Balance Sheet.

In the *Agricultural News* of February 17th is given the first annual report of the Directors of the Antigua Central Sugar Factory.

Some adverse circumstances have been encountered, in particular the severe drought which seriously affected the amount of canes supplied to the factory. This proved very unfortunate, since the factory is quite capable of dealing with 3,000 to 4,000 tons of sugar in three to four months.

Directors' First Annual Report.

The Directors are now able to submit their first annual report, together with a statement of the accounts to September 30th, 1905, embracing the first year's working of the new factory.

The factory buildings, plant, machinery, &c., were supplied and erected under contract with the Mirrlees Watson Company, Limited, of Glasgow, and their work, as also that of Mr. Claude T. Berthon, the Company's consulting engineer, has given every satisfaction. The public opening took place on December 19th, 1904, just eleven months after the contracts were given out.

Owing to prolonged drought, the cane crop on the island during last season was reduced to a figure which it has touched only three times in the last twenty years, and had it not been for the high prices that prevailed for sugar during the early part of 1905, the results of the year's working would have been disappointing. As it is, they have come fully up to, and have even exceeded, expectations, for, after paying all expenses, besides debenture interest, and setting aside the agreed sum of £2,000 for sinking fund, and also £1,000 by way of reserve fund, under the powers reserved to the Directors in the Articles of Association, there remains a surplus for the year of £3,956 9s. 8d. Of this, 2s. 6d. per ton, or £43, has been allocated to outside estates in respect of canes contributed by them. One moiety of the remainder, or £1,942 10s. 10d., is payable *pro rata* to the "contracting planters," and equals nearly 2s. 6½d. per ton of canes. The other moiety belongs to the shareholders, but in view of the uncertainties of the future, it is thought prudent for the present not to distribute this, but to place it to their credit to be distributed hereafter as circumstances may permit.

The factory was designed for an output of 3,000 tons of sugar per annum. Owing to the short crop, it will be seen that the output last season did not much exceed one-half of this, the planters supplying under 15,500 tons, and the peasants only 181 tons of cane, instead of the 25,500 and 4,500 tons, respectively, that were anticipated. As the expenses and fixed charges would not materially increase with a full output, it is evident that, in a normal year, sugar can be produced at this factory at a very low cost.

The accounts have been drawn so as to show results clearly, and in as much detail as is consistent with due brevity. The averages per ton of both production and cost are given.

Two of the Directors, Mr. DuBuisson and Mr. Moody Stuart, paid visits to the island at different dates, in order to overlook the arrangements, and to keep in touch with the staff. They were well satisfied with all they saw, and can testify to the industry and efficiency of all the officials and employees of the company.

In accordance with the Articles of Association, Mr. DuBuisson retires from the Board of Directors, but is eligible for re-election. The firm of Messrs. Wenham, Angus & Co., Chartered Actountants, London, were nominated by the Board as auditors of the company. They retire, but offer themselves for re-election.

THE ANTIGUA SUGAR FACTORY LIMITED.

Balance Sheet, September 30th, 1905.

Liabilities.	£	s.	d.	£	s.	d.
To Creditors..				564	11	8
,, Share Capital:—						
12,500 'A' shares, 1s. each, fully paid	625	0	0			
12,500 'B' ,, 1s. ,, ,,	625	0	0			
				1,250	0	0
,, Debentures:—						
250 'A' debentures, £100 each	25,000	0	0			
15 'B' ,, £1,000 ,, ..	15,000	0	0			
				40,000	0	0
,, Reserve Fund				1,000	0	0
,, Profit and Loss:—						
Balance at credit of profit and loss account				3,928	1	8
				£46,742	13	4

Assets.	£	s.	d.	£	s.	d.
By Cash in hands of agents	994	1	2			
,, Debtors	588	17	7			
,, Stocks and stores in Antigua	1,010	19	10			
,, Stocks of materials and spare parts	790	0	0			
				3,383	18	7
,, Capital Expenditure:—						
Land, buildings, plant, and machinery	33,815	12	1			
Dwelling-houses and other buildings	1,279	9	7			
Railway construction	5,518	13	11			
Railway rolling stock	2,548	9	7			
Preliminary expenses	946	9	7			
Discount on debentures	1,250	0	0			
Deduct—	£45,358	14	9			
Written off by way of sinking fund.	2,000	0	0	43,358	14	9
				£46,742	13	4

Profit and Loss Account for the year ended September 30th, 1905.

To Canes purchased:—

	Tons.	Cwts.	Qrs.	s.	d.	Per Ton. £	s.	d.
Contracting planters	15,333	17	1	11	7	8,885	5	5
Outside estates	344	0	0	12	9	219	7	7
Peasant growers	182	5	3	11	4	103	15	2
	15,860	3	0	11	7	9,208	8	2

To Factory charges:—

	£	s.	d.	£	s.	d.
Salaries	1,080	18	1			
Wages	828	10	7			
Fuel	337	8	7			
Stores, including bags	603	2	6			
Repairs and maintenance	710	0	9			
Fire and storm insurance	138	5	9			
Cartage and lighterage of sugar	387	4	11			
				4,085	11	2

(Per ton of sugar, £2 10s.)

To Railway transport expenses:—

	£	s.	d.	£	s.	d.
Wages	91	11	5			
Fuel	57	16	0			
Stores	35	0	0			
Repairs and maintenance	183	1	10			
				367	9	3

(Per ton of sugar, 4s. 6d.)

To Administration charges :—						
Directors	250	0	0			
Travelling	140	9	3			
Legal and professional	50	0	0			
Stationery, books and petties ..	55	14	1			
Telegrams and postage	168	0	5	664	3	9
(Per ton of sugar, 8s.)						
To Interest :—						
Debenture interest	1,434	14	6			
Less credits	99	14	3	1,335	0	3
To Sinking Fund	2,000	0	0			
,, Reserve ,, ...	1,000	0	0			
,, Balance :—						
Payable to outside estates (say 2s. 6d. per ton of canes)	43	0	0			
Payable to contracting planters (say 2s. 6½d. per ton of canes)	1,942	10	10			
Shareholders' proportion..	1,942	10	10	3,928	1	8
				£22,588	14	3
By net proceeds of sugar, &c., produced :—						
Sugar, 1,634½ tons (£12 15s. 5d. per ton)	20,873	9	11			
Molasses, 77,000 gallons (5¼d. per gallon)	1,685	4	4	22,558	14	3
,, Sundries				30	0	0
				£22,588	14	3

Abstract of working of the Factory during 1905.

Tons of cane	15,860·6
Gallons of diluted juice*	2,437,500
Cane sugar in juice, pounds	4,427,472
Sugar made, 1st, 1,600 tons }	
,, ,, 2nd, 35½ tons = ,, 30 ,, }	
,, ,, as first sugar, tons	1,630
,, ,, ,, ,, pounds	3,651,200

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* Average composition of diluted juice :—

Cane sugar	16·89	per cent., 1·835 lb. per gallon.
Glucose and non-sugar..	2·04	,,
Total solids	18·93	,,
Purity	89·23	,,
Average sucrose in megass	7·6	,,
,, water ,, ...	49·5	,,

Commercial sugar per 100 of cane sugar in juice, *i.e.*, "extraction"	82·46
Gallons of molasses	77,000
Molasses per ton of sugar	47·24
Tons of cane per ton of sugar	9·73
Cords of wood used	371
Tons of coal (chiefly locomotives)	57
Days working	86
Hours grinding	1,063

NOTE.—The canes have yielded 10·31 per cent. of sugar, or 9·70 tons of canes to one ton of sugar.

THE INFLUENCE OF LIGHT ON THE DEVELOPMENT OF THE SUGAR BEET.

Siegfried Strakosch, discussing at length in the *Zeitschrift für Zuckerindustrie* the influence exerted by sunlight and diffused daylight respectively on the growth of sugar beets, comes to the following conclusions:—

1. The sugar beet can attain normal maturity under a light permanently diffused, presuming the latter to be of sufficient strength.
2. Nevertheless, under direct sunlight an improved growth takes place, being especially shown in the increase in substance; more so in the roots than in the leaves.
3. The absence of direct sunlight results in a certain increase in non-sugar in the beet juices, as well as in a decrease of the sugar content. The latter is not, however, influenced to the same extent as is the size of the root.
4. Leaves in full sunlight reveal, as compared with shaded leaves, larger stomata, likewise a different arrangement of the latter, *e.g.*, a larger number of stomata on the upper sides, and a smaller number on the undersides.
5. Assimilation proceeds more slowly in the case of shaded leaves.
6. With an increase in the intensity of the light, the mono-saccharides decrease in their proportion to the di-saccharides in the leaves.
7. Among the mono-saccharides of beet leaves, dextrose is apparently the most prevalent.
8. There exist degrees of content under which the raw sugar in the leaves is to be regarded, not as an intermediate product, but as a completed substance in reserve, which as such may make its way into the body of the root.

THE CUBAN SUGAR INDUSTRY.*

By W. D. Horne, Ph.D.

The relative importance of Cuba as a sugar-producing country may be seen from the fact that of the 12,000,000 long tons of raw sugar produced annually in the world, Cuba furnishes about 1,000,000 tons. Excepting the small amount used on the island for local consumption the total product is shipped to the United States refineries.

This constitutes about 40 per cent. of the sugar consumed in this country, the total U.S. supply coming last year as follows:—

	Tons.
From Cuba	1,101,611
,, Foreign countries	438,383
,, Hawaii, Porto Rico, Philippines ..	516,098
,, home-grown cane	355,402
,, ,, beet..	220,722
Total	2,632,216

The sugar cane was early brought to the West Indies by the Spaniards, and it soon became an important crop, flourishing phenomenally in the fertile soil and hot, damp atmosphere of these tropical islands. In Cuba the sugar crop amounts in value to some 75,000,000 dollars, and constitutes by far the largest part of the total exports.

Prior to the late Cuban insurrection, in 1895, the annual crop had amounted to a million tons, but during 1896 and 1897 it dropped to a little over one-fifth of this amount, and remained at only about one-third of a million for several years, owing to the widespread devastation of cane-fields and destruction of factories during the period of hostilities between the Spaniards and the Cubans. But since the war the rehabilitation of the sugar industry has been continuous and rapid. Cuba is about 700 miles long by 50 miles wide on the average, and consists principally of limestone formation with some hills and mountains of older geological periods occurring at both ends and in the centre of the island. The principal cane belt is the comparatively level strip of country extending almost round the island near the coast. The sugar lands are commonly known as of the red and the black varieties. The former are deprived from highly ferruginous limestone and constitute the best sugar lands in Cuba. While this soil is very sticky and heavy when wet, it is extremely pervious to water, drains well, and is easily worked when not freshly drenched by rain. The black land occurs largely in the hilly parts, where it is underlaid by white calcareous subsoil, and in the level districts, where it is underlaid by a yellow or brown clay subsoil. The black land is heavier and more tenacious than the red, loses water very slowly, and until it is fairly well dried is difficult to work.

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* Read at a meeting of the New York Section of the Society of Chemical Industry.

The rainy season extends from June to December. The manufacture of sugar is restricted to the dry season, extending from December to June, for during the wet weather the cane cannot be handled from the fields in the ox carts used.

Usually cane is planted in hillocks 3 ft. apart in rows 5 ft. apart. Of late the system of Dr. Zayas, in which the hillocks are planted 9 ft. by 12 ft. apart, has been strongly advocated as affording means of cultivating by machines drawn by animals and yielding a greater number of successive crops of richer cane. It is apt to yield less than the ordinary method during the first year, and, as yet, there have not been enough data collected to show conclusive results.

Ten successive crops can commonly be harvested in as many years from one planting, although in some cases many more can be had. The yield gradually diminishes, though the juice increases in density and in purity as the plants grow older in years. The average yield is probably 15 to 20 tons of cane per acre, though it may run up to four times this amount. When the land becomes exhausted the custom is to let it lie for some years, using it for pasture land. Only about one-fifth of the arable land is under cane cultivation, and intensive methods of agriculture are little known. Some experiments with fertilisers have been conducted with results indicating success when the price of sugar is not abnormally low. On some estates it is customary to spread the filter press cakes and the bagasse ash upon the fields, while in other places these are wasted.

In some experiments in Matanzas Province the yield of cane was increased from 28·73 tons per acre to 41·08 tons by the use of about 200 lb. sulphate of potash and 400 lb. of acid phosphate on plots of an acre, while the further addition of 2000 lb. of slaked lime to the above brought the yield up to 45·94 tons per acre.

The principal varieties of cane grown are the crystalina, blanca and a red or purple-striped variety. Cuban cane does not suffer so much from the ravages of disease and the attacks of insect and parasitic enemies as the cane does in some other countries. But great losses of cane are sustained annually through destructive fires which often sweep through scores of acres before they can be checked. As a precautionary measure against the spread of fire, it is customary to leave lanes about 30 ft. wide unplanted between the rows at distances of about 100 yards, and broader avenues at right angles to these lanes and about twice as far apart. The latter are commonly planted with rows of plantain trees, which serve the double purpose of affording protection against the spread of fire and a very acceptable article of food in their fruit. As the cane ripens the leaves dry up and fall into a thickly-tangled and very inflammable mass which is almost impassable. A fire once started in this, whether by design or by chance spark, spreads rapidly, and in a high wind such as frequently prevails, sweeps along with fearful rapidity. Strangely enough, the cane itself survives the fire pretty well, being protected by its very tough siliceous rind and its abundant internal juice. But burnt cane must be cut, transported and crushed within four days or it will ferment. Should it be rained upon it will deteriorate sooner. Sugar made from it is usually dark and less desirable for refining. So disastrous is a cane fire apt to be that its intentional malicious setting has at times been treated as a capital offence.

In Cuba the factories usually obtain their supply of cane in part or altogether from farmers who raise it on their own land or on land belonging to the factory. These "colonos," or managers of cane colonies, contract with the factory to furnish cane to be paid for in 96° raw sugar, varying in amount from about 4 per cent. to 6½ per cent. of the weight of the cane as delivered to the mill. When cash is paid it is still on the same basis, and the cash value of the sugar is estimated from the average daily quotations in the Havana market. Colonos operating on land owned by the factory usually have a five or ten year contract.

The cane is cut by hand with broad-bladed machettas or cutlasses, stripped of all leaves and tops, cut into pieces about three feet long, and thrown into piles, whence it is picked up and carefully packed into ox carts, which transport it directly to the mill or else to the railroad, where it is loaded upon the cars either by hand or by mechanical hoists which raise the entire cartload at once.

It is well known that cane once cut will deteriorate if allowed to remain long on the ground. In order to ascertain the rate of deterioration, I made a series of analyses on cane exposed to the weather during six days. I cut 15 canes as nearly alike as possible and crushed five in a handmill at once, after having divided them into thirds of equal length, marked bottom, middle and top. The other 10 canes constituted the sample whose deterioration upon standing was to be noted. I cut one-sixth off the bottom of each, pressed them, and analysed the composite juice. Next day I took the next sixth off, and so continued for six days. There was a natural deterioration, as I took samples nearer to the top each day, but there was a further falling off in test due to the deterioration of the juice itself with time, and this latter can be arrived at by comparing with the other figures as a guide.

The five canes first tested:—

	Brix.	Sucrose.	Purity.	Glucose.
Bottom third	18·85	16·95	89·90	0·37
Middle ,,	18·95	16·60	87·59	0·62
Top ,,	17·65	14·20	80·47	1·27

The 10 canes exposed to the weather:—

	Brix.	Sucrose.	Purity.	Glucose.
Bottom sixth, fresh ..	19·10 ..	16·97 ..	88·85 ..	0·62
Next sixth, 1 day old..	18·75 ..	16·40 ..	87·48 ..	0·75
,, ,, 2 days old..	18·70 ..	15·93 ..	85·20 ..	0·93
,, ,, 3 ,, ..	18·50 ..	15·62 ..	84·46	0·96
,, ,, 4 ,, ..	17·85 ..	14·35 ..	80·42 ..	1·29
Top ,, 5 ,, ..	17·00 ..	11·86 ..	69·77 ..	2·25

A careful study of the above will show that the deterioration in purity during the first day is about 0·25 per cent.; in the next two days, about 1·75 per cent.; and, in the next two days, abour 4 per cent. It has been suggested that this rate of deterioration may be partly due to the relatively rapid deterioration in the freshly exposed ends presented by each day's cutting.

The ox carts carry from about two to five tons of cane, and the railroad cars employed hold from 10 to 15 tons.

Many estates rely wholly upon the public railway service, while others supplement this with standard or narrow-gauge tracks, cars and locomotives of their own for operation within the confines of the estate.

About one-twentieth of the area of Cuba is under cane cultivation, which is said to be about one-fifth of the area on which cane could be suitably grown. The paucity of population has been the limiting factor in sugar production.

Just before the war there were about 180 factories manufacturing raw sugar, while in 1897 there were only 77 operating, the number rising last year to 177, making on the average per factory about 45,000 bags of 325 lbs. of sugar each.

Many of the factories which were more or less demolished during the late war have been rebuilt, while others have remained in an abandoned condition. Meanwhile a new era has begun, with the advent of large amounts of American capital, in the building of new factories, some of which exceed any of the old ones in magnitude. But most striking of all the advances made are the improvements in scientific operation of the plants and the great attention paid to chemical control.

Cuban sugar factories are, as a rule, well equipped with modern machinery. The old muscovado sugar, boiled in open kettles and drained by long standing, is practically obsolete; while a high grade of centrifugal sugar, polarizing about 95·5 to 96·0 is the almost universal product of the factories equipped with modern sugar machinery from France, Germany, England, and the United States.

The march of improvement in sugar machinery is rapid and continuous, the efforts of the administrators of estates to perfect their plants are unflagging, and everybody on the island seems keen to learn of any advance and to apply it to his needs. The pride of excelling runs high, and on every hand one finds estates famed for and priding themselves upon some point of transcendent superiority. One claims the finest milling department, another the broadest acreage of cane, a third the most economical arrangement of working parts, while the strife to produce the greatest output in bags of sugar and the highest yield of sugar from cane are never-ending. A number of the factories are veritable show places, and not a few of the owners' residences are little short of palatial.

From the time when the cessation of the rainy season permits the cutting and hauling of cane, and the mills begin to grind, work is continuous day and night, with the exception of Sundays, until the rains come again late in the spring. The men work in alternate shifts of six hours each, the heat rendering a longer period less satisfactory.

Cane arriving at the factory by cart or railroad is unloaded upon the cane carrier either by hand or mechanically by a cane hoist lifting five or six tons at a time. Chains or wire ropes are pushed under the load of cane between transverse slats on the platform of the car or cart, the ends attached to the support above, and the load lifted bodily into the air, transported to a suitable hopper above the carrier, and there dropped by the pull of a trigger. In some cases, the cane is gradually discharged from the hopper upon the carrier by means of a revolving drum or travelling apron provided with strong hook-like teeth; in other cases, the hopper is built at the bottom of a trough 6 ft. or 7 ft. wide by about half as deep, and leading up at an angle to the crusher. In the bottom of this trough is the carrier, an endless apron of wooden or metal slats or plates, or in the later models of steep ascent a link belt conveyor of great strength provided with strong steel teeth 18 in. long, curving slightly forward to elevate the heavy tangled mass of cane which falls upon it. The mass of canes in a rough layer, 12 in. or 18 in. deep, falls precipitously over the upper apex of the carrier into a hopper-like receptacle, which feeds it into the preliminary crusher, consisting of two enormously strong horizontal steel rolls provided with interlocking ridges to grip, crush and tear the cane. The Krajewski crusher, with zigzag serrated corrugations, appears to give the best results. The Marshall, with alternating plain rings and rings of interlocking teeth, also gives very good results, although it appears to allow of more slipping than the other. These rolls are usually 30 in. to 34 in. in diameter and 6 ft. or 7 ft. long. They are set an inch or two apart, and can separate still farther by pushing back against very heavy spiral steel springs. The crusher is generally driven by a separate engine and exerts a tremendous pressure upon the incoming cane. Nearly half the juice of the cane is extracted here, and the cane, torn open and often cut into short lengths, passes by a travelling conveyor to the first mill proper, which consists of three rolls set closely together, the lower two in the same horizontal plane and the upper one centrally above the other two, and so placed as to leave an aperture of about 2 in. between the upper roll and the lower roll on the entering side and 1 in. between the upper roll and the lower roll where the crushed cane or bagasse passes out. Immediately beneath the upper roll, and bridging the space between the two lower rolls, is a curved plate, called the trash turner, which prevents the bagasse from passing down between the lower rolls, but feeds it across into the space between the upper and the second lower roll. One or two other similar sets of rolls follow, set with successively decreasing apertures between rolls so as to exert even greater pressure on the more and more exhausted bagasse. These mills are preferably provided with hydraulic pressure pistons, either pressing directly downward upon the upper roll or horizontally against the lower roll at the outgoing side. From 300 to 420 tons pressure or more can thus be exerted. It is usual to have the highest pressure upon the last mill and to operate this by a separate engine.

It is of great advantage to macerate the bagasse issuing from the first and second mills by sprinkling water upon it. This is very rapidly absorbed and, diluting the juice remaining in the cane, permits of a greater extraction of sugar at the next compression. The hotter the maceration water the more rapid is its diffusion, but if it is very hot it causes the roll journals to become overheated. For this reason, cool or tepid water is generally used. Some rolls are made with hollow shafts which permit of cooling by means of cold water. The amount of water of maceration added thus at the mills usually varies from 3 to 8 per cent. of the weight of the cane, being limited by the expense of its subsequent evaporation. This leaves in the bagasse about 7 to 9 per cent. of sucrose, equal to from 2 to 2½ per cent. of sugar on the weight of cane. In Hawaii, where 20, 30, or even 40 per cent. of water of maceration is added in two or three instalments, the extraction of sugar is much more thorough, only 4·5 per cent. of sugar being left in the bagasse, equal to 1 per cent. on the weight of cane. A crusher and three triple mills will extract about 72 lbs. of juice from 100 lbs. of cane, when no maceration water is added, the crusher and first mill extracting 45 lbs., the second mill 20 lbs., and the third mill 7 lbs. approximately. The juice first extracted comes from the soft interior, and has a higher density and purity than that which is extracted by the subsequent milling under higher pressure. The second and third mills extract a greater relative quantity of juice from the rind, and it has a darker colour as well as lower density and purity. The following determinations were made on juice from the different mills in different factories:—

Plantation.	Brix.	Pol.	Purity.
		Crusher and first mill.	
1.—1904	18·11	16·0	88·34
1.—1905	17·63	15·64	88·76
2.—1904	20·1	18·3	91·04
2.—1905	19·75	16·9	85·5
3.—1904	20·00	18·19	90·97
3.—1905	18·70	16·76	89·60
4.—1905 (no crusher)	17·4	15·51	89·13
5.—1905 (,,)	19·16	17·09	89·12
		Second mill.	
1.—1904	17·16	15·2	88·52
1.—1905	16·95	14·66	86·51
2.—1904	19·06	16·4	86·04
2.—1905	19·05	16·05	84·2
3.—1904	18·85	16·49	87·46
3.—1905	18·55	15·99	86·21
4.—1905 (no crusher)	16·6	13·38	85·97
5.—1905 (,,)	18·01	15·11	83·9
		Third mill.	
1.—1904	15·56	13·0	83·55
1.—1905	16·40	13·7	83·56
2.—1904	18·68	15·8	84·57
2.—1905	18·5	15·2	82·16
3.—1904	18·68	16·10	86·21
3.—1905	17·25	14·68	85·09
4.—1905 (no crusher)	—	—	—
5.—1905 (,,)	17·98	14·98	83·36

The greatest economy of evaporation is reached when double or triple maceration is practised, but with only a single application of water. The water is always applied before the final crushing, but the diluted juice thus obtained may be carried back and used for macerating before the second mill. Or the thin runnings from filter presses may be used in the same way. This system has found its highest development in Egypt, where the juice is carried back twice, and where two-thirds of the extracted juice is taken from the crusher, the rest from the first mill.

When the utmost pressure is applied at the last rolls they emit a groaning or singing tone, and the bagasse, heated considerably by this enormous compression, issues like a mat of shavings and contains from 48 to 53 per cent. of moisture. It is conveyed in this condition by travelling slats through long shallow wooden troughs to the furnaces, where it is burnt upon special grates, and, under suitable conditions, constitutes the sole fuel required for the plant.

The combined juice from the crusher and all the mills flows through a finely perforated brass straining plate into a small receiving tank, and is pumped into the liming tanks, where milk of lime is added to it immediately to neutralize acidity and to precipitate those impurities which form insoluble lime salts. Some mix powdered burnt lime with a pailful of juice and add this to the general mass, but the use of milk of lime kept constantly at 12° or 15° B. is greatly to be preferred. The amount of lime required to give the best results is an unsettled matter, some adding enough to produce a neutral or slightly alkaline reaction to litmus, others carrying it further, to alkalinity to phenolphthalein. In my experience, the lime continues to give a precipitate after mere neutrality to litmus has been reached, and to obtain a bright and clear defecated juice, it is necessary to add lime up to a point somewhere between neutrality to litmus and neutrality to phenolphthalein. In juice from cane of several years' growth from lands long under cultivation and having a purity of 90, I found that lime added to cover 20 per cent. of this range was sufficient, while in a juice of 80 purity, obtained from new cane on virgin soil it was necessary to cover the full range to get the best results. I doubt whether it is ever necessary to add more lime than to reach neutrality to phenolphthalein to effect a good clarification, while for other reasons an excess is objectionable. Liming tanks almost always serve as measuring tanks also, the juice overflowing through an overflow pipe or marking its height by some float device. In the older establishments, it is customary to heat the limed juice in the same tanks as limed and measured in, by means of steam-jacketed bottoms or closed steam coils. In this case, a portion of the precipitate of lime salts, albuminous and pectinous matter, &c., falls to the bottom, and part rises to form a heavy blanket scum on top. The heating continues until this blanket cracks, at about 190° F., after which a period of subsidence is allowed, and then the clear juice is suitably drawn off. In some of the newer plants, the Deming system of superheat defecation, so widely employed in Louisiana, is used. In this, the limed juice is heated to 130° or 140° F. under pressure, cooled again, and then passed through continuous settling tanks of 5000 galls. capacity, having an internal conical diaphragm to direct the current of juice, and an inverted conical bottom to collect the precipitate. If the current flows slowly (5 ft. an hour), and the mud is removed from the bottom frequently (15 minutes), a fairly clear juice can be had, but it seldom is so bright as that obtained by open defecation. The slight turbidity can be removed, however, by filtration through Danek or gravity filters.

This system effects no materially better precipitation of impurities than the ordinary process, as shown by a set of experiments in which some limed juice with a purity of 83·65 showed a purity of 84·53 after being heated to boiling in an open vessel and filtering, as against 84·62 after being heated in the Deming to 240° and filtered. Prinsen Geerligs has arrived at a similar conclusion from experiments in Java. Still, the apparatus is economical to operate, and has a very great capacity. Probably better results in settling could be had if the tanks were used as intermittent instead of continuous settlers.

(To be continued.)

THE OCCURRENCE OF LEVULOSE IN NORMAL CANE JUICE.

By Noel Deerr.

In the *Berichte der Deutschen Chemischen Gesellschaft* (1905, **38**, pp. 3308), E. Pinoff recently published a series of observations on colour and spectral reactions of the most important sugars. One qualitative test for levulose promises to be of a considerable use in sugar factories. The test is thus given by its author:—

·1 gram of the material to be tested is heated on a water bath with 10 c.c. of a 4% solution of ammonium molybdate, 10 c.c. of water and ·2 c.c. of glacial acetic acid. Levulose after three minutes gives a fine blue colouration. After 30 minutes, galactose, mannose, rhamnose, sorbose and arabinose give a faint green colouration. The absence of free mineral acids is specified in this test, as in their presence most sugars respond.

The author of this test states that it is so delicate that it may form the basis of a quantitative analysis of levulose.

From isolated references in the literature of the sugar cane, it may be gathered that the presence of levulose in normal canes, that is to say, in absolutely sound, healthy plants, is a matter of dispute. Wiley, in his Agricultural Analysis, Vol. III., page 234, mentions the doubt that exists as to the exact nature of the reducing bodies of the cane: and in this Journal, No. 55, he gives instances of canes in which reducing bodies are totally absent.

In a recently published book, "The Polariscope in the Chemical Laboratory," by Mr. G. W. Rolfe, appears the following remark: "Many authorities hold that the glucoses of the cane plant are not present as constituents of invert sugar, as apparently they are optically inactive." Whether levulose or not occurs in normal cane, its presence in the canes received at a factory is undoubted, as a certain proportion of insect or fungus-damaged as well as overripe canes, are always present. In addition, there is the inversion that occurs at the exposed surface of the cut cane.

I have applied the test given above to the juice extracted by very moderate pressure from carefully selected canes, free from any sign of outward injury, or of deterioration due to fungus. In all cases the test indicated the presence of levulose. I applied the test in two ways. In the first way the juice was clarified with the minimum amount of lead acetate, and to the filtered juice was added an equal volume of Pinoff's reagent. Although the filtered juice did not throw down lead when treated with a soluble sulphate, the molybdate caused a precipitation of a lead salt which was extremely hard to separate by filtration. On allowing the mixed solutions to settle and then heating as described, a blue colouration became distinctly apparent. In the second way the expressed juice was filtered over reduced pressure through asbestos, when a quite clear, faint, yellow material was obtained. This treated with the molybdate reagent, gave either a green colouration or one distinctly blue, in the former case the blue colour being masked by the yellow colour of the juice. Juice obtained from the tops of canes reacted much more strongly than juice obtained from other parts, and, as it is known that the "glucose" of the cane is present there in greatest proportion, this would be further evidence that levulose is a constituent of normal cane, since there is no reason to suppose that the young top is more liable to suffer inversion in its sugar content than are the other parts.

SUGAR CANE CULTIVATION IN SPAIN.

Spain is the only country in Europe which produces cane sugar; the industry is carried on throughout that part of Andalusia lying between Almeria and Gibraltar, this being the only part of the peninsula which possesses the necessary climatic conditions for the propagation of the sugar cane, in other words, an average high temperature and an almost complete absence of frost.

This suitable temperature only exists near the sea coast, and it is only in the irrigated portions of land chiefly on the alluvial soils forming the centre of the valleys that the cultivation of cane is carried on.

The nature of these soils varies greatly, and excellent plantations exist as well on light and silicious soils as on heavy clay lands.

The yields of cane are specially good where the arable stratum is deep and well watered, providing one is content to plant red or ribbon canes on the light soils, and not white canes which will in this case give only a poor return.

In addition to the three principal varieties of canes just mentioned, there exist others of secondary importance, such as the white edible cane, which is very rich but has a very poor yield; and the prickly-haired white which is now being abandoned owing to the labour of handling it, and the mediocre quality of its contents.

The white canes only thrive on well manured soils of good quality; their mean sucrose content may reach 15% of the weight of cane with a glucose content of 0·6%, and the yield per acre attains to from 18 to 20 tons in the best situated plantations.

The first crop easily ripens within a year, but the same is not the case with the second and succeeding crops which take at least two years to grow.

The red canes, which are much more hardy than the white variety, are very responsive to manuring, whatever be the nature of the soil, and under good conditions are able to yield crops as high as 32 tons of cane to the acre.

Cutting is carried on every year, and may be repeated for five or six consecutive years during which the yields remain high so long as care is taken to replenish the soil each year with abundant and easily assimilable manures.

The average sucrose content of the red canes is inferior to that of white canes, and, as is the case with the latter, decreases in proportion to the distance from Gibraltar going east. In the plains of Malaga its mean is 13 to 14% with 0·5 to 1·2% of glucose.

The ribbon canes compare with the red ones in yield of cane but are extremely variable in their character and in their sugar content. All these species of canes are cultivated after the same manner.

The land after a rest of at least three years during which it is used for the cultivation of wheat, barley, maize, or sweet potatoes, is kept in condition by light dressings, till the time when it is prepared for planting. This preparation of the soil consists of a deep ploughing given in January or February and at the same time large quantities of farm manure, 12 or 16 tons to the acre, are spread and turned in. This heavy tillage is followed in March by a ridging of the field which leaves trenches 12 in. deep and 8 in. of breadth sloped out to 3 ft. 6 in. These trenches are slightly deepened and then smoothed with hand hoes; and at the bottom may be placed manure if only a small amount of the latter has previously been ploughed in.

The dressing being complete, the ground is now ready to receive the canes which are placed in position on each side of the furrow in two continuous parallel rows, taking care to place the eyes all in the same horizontal plane and to straighten the bent cuttings by making transverse gashes in them so that they fit the bottom of the furrow.

As much as 10,000 lbs. of cuttings is planted to the acre.

The most advantageous distance between the rows is about one metre, as the double row of plants in each line is necessary, partly owing to the relatively weak vegetation of the cane (which is a tropical plant) in the temperate climate of the Andalusian coast, and partly owing to the risk of rotting to which the cane is exposed in being planted at a time of the year often wet and cold.

The canes after being lightly covered with soil receive if necessary a first watering which gives the soil a freshening that ought to last the whole period of vegetation. In proportion as the canes appear and grow up, the furrows are filled up, whereupon the field is levelled by hand hoeing or better still by light ploughing.

After this operation one proceeds to bank up the young stalks by means of a ridging plough which makes between each line a trench in place of the original ridge. These trenches are all connected up alternately, so that the irrigation water may flow gently up and down them from one side of the field to the other, following the natural lie of the land.

Irrigation is carried out during the summer every 10 or 15 days, and it is estimated that each time about 263 cubic yards of water per acre are used up.

In many instances of cultivation, the action of stable dung is completed with chemical manures; these consist principally of superphosphate of lime, sulphate of ammonia, nitrate of soda, and sometimes fish guano derived from the sardine and tunny fisheries, and basic slag.

Experience shows that the best results are obtained by applying the slag before the deep ploughing; the guano, the superphosphates, and two-thirds of the sulphate of ammonia in the trenches before planting; and the rest of the sulphate and the nitrate as a covering before earthing up the young plants.

These artificial manures when well applied stimulate the plant's growth especially at the commencement when the temperature is moderate, and ensure a big development before the period of ripening begins.

Maturity occurs when the proportion of reducing sugar to crystallizable sugar is a minimum; this generally takes place in March. Thereupon cutting begins and lasts into May. The canes are cut with a hatchet nearly at the ground level.

When the crop is reaped, the ground is rid of all the white tops, which form an excellent food for cattle. Then the greater part of the leaves are collected in heaps by means of chain harrows drawn by oxen, and are used as litter; what cannot be economically gathered is burned on the field; this has the advantage of destroying a large number of insect pests.

Manure is then scattered over the ground (either farm dung or guano), and the soil is loosened by passing a ploughshare as near the stumps as can be done without damaging them. This tillage is finished off by hand with a small hoe of special design, while the protruding stalks are trimmed with shears, so as to leave but two eyes on each shoot and thereby prevent the growth of too many ratoons.

After applying a manure composed of superphosphate and sulphate of ammonia, and having lightly recovered the whole, the stumps are earthed up bit by bit as the young shoots grow. Sulphate and nitrate are also laid on previous to the last dressing, and then irrigation follows as in the case of new plants.

After the following crop, the shoots should be cut off as close to the stump as possible; otherwise all the operations remain the same as before, and recur as long as the plantation gives satisfactory yields.

All these costly dressings are rendered necessary owing to the difficulty of getting rapid development of sugar cane in Andalusia, as also owing to the necessity of obtaining the utmost sugar possible in the very limited area set apart for this cultivation.

The canes fetch 30 to 40 pesetas* per ton delivered at the factory; consequently their cultivation is one of the most remunerative occupations in Spain, in spite of the high cost of production.—(M. Paul Bouvier in *Bulletin des Chimistes.*)

AN APPLICATION OF PINOFF'S LEVULOSE-MOLYBDATE REACTION.

By NOEL DEERR.

The levulose-molybdate reaction of E. Pinoff† would appear to possess a very valuable application in the sugar factory in detecting and in estimating the small quantities of sugar that occur in the waste and condensed waters.

As given by its author the test is one for levulose, but since sugar gives levulose as one of its inversion products, the test, with small modification, is applicable to cane sugar. In addition, glucose reacts similarly to levulose in the presence of mineral acids.

In testing waters for small amounts of sugar, I have employed a molybdate solution of the same strength as that specified by Pinoff, but with the addition of 2 c.c. of hydrochloric acid per 100 c.c.

Equal parts of this solution and of the water under examination are heated on a water bath for three minutes. At the end of this time a water containing 1 part of cane sugar per 10,000 gives a distinct blue colouration. At this dilution the blue tint can not be seen in a test tube one-half inch in diameter if the latter be looked at against a neutral background, such as the wall of a room, but is quite apparent if the test tube is held up to the light against a background of white paper.

As indicated by the originator of the test, the reaction is probably quantitative, and a series of standard colours may be prepared corresponding to cane sugar, 1 per 1000, 1 per 2000, &c. In this way the amounts of cane sugar in factory waters can be readily estimated. The blue tint may be very easily matched by solutions of copper sulphate, and a series of test glasses made up to correspond with the colouration produced by definite quantities of cane sugar tested always under one and the same condition.

This test seems to the writer much more satisfactory than the well-known alpha-naphthol reaction, the latter being too sensitive for general use in a sugar factory.

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* 1 peseta = 9½d.

† Described on a previous page.

MANURIAL EXPERIMENTS WITH SUGAR CANE IN THE LEEWARD ISLANDS, 1904-5.

The annual report of manurial experiments with sugar cane in the Leeward Islands as carried out by the staff of the Imperial Department of Agriculture for the West Indies lies before us.

In a preface Dr. Morris summarizes the object and results of these experiments. He writes:—

"The objects of the experiments, which were conducted on eight estates in each island, were to find varities of sugar cane which were likely to increase the output of sugar, and to aid the planters in combating the ravages of fungoid diseases and insect pests.

"The climatic conditions in Antigua during the season were very unfavourable. The effect of the severe drought was such as to cause the sugar crop of the island to drop to 7,800 tons, while the average crop, in normal years, is about 13,000 tons. In St. Kitt's, it may be mentioned, the rainfall, though heavier than in Antigua, was very irregular; consequently, some estates made good crops and others very poor ones.

"At Antigua, in the experiments with plant canes during the season, the results show that seven canes, viz., B. 156, Sealy Seedling, B. 306, B. 208, D. 74, D. 95, and D. 109 stand out as specially worthy of attention. It is important to note that the first six of these appeared as the first six in last season's results. They are therefore to be recommended as worthy of being safely, though cautiously, introduced into cultivation in Antigua. This opinion is strengthened on reference to the results with the experiments with ratoons, for the same six canes have done best at the various stations as ratoons also.

"In St. Kitt's, the best results as plant canes were obtained with Caledonian Queen or White Transparent. The Barbados Seedling canes, B. 208 and B. 147, were also grown in St. Kitt's with satisfactory results. In addition, the Demerara Seedling canes, D. 74 and D. 116, are recommended for cautious planting. The Barbados cane B. 208 heads the list of canes grown as ratoons in these experiments with a yield of 30 tons of cane and 8,508 lb. of sugar per acre in the juice. Dr. Watts is of opinion that this cane may be generally introduced into cultivation in St. Kitt's, where it will occupy a useful position with the Caledonian Queen and B. 147.

"There was an almost complete absence of rotten canes in the cane fields of the colony during the season. As this is directly traceable to the introduction of new varieties of cane, the great value and importance of these experiments are clearly demonstrated."

A NEW SOURCE OF LOSS IN SUGAR FACTORIES.*

By H. PELLET.

Losses in sugar factories occur at different stages of manufacture. The following is a list of those observed during operations (excluding diffusion):—

1. In the scums more is lost as a rule than is indicated, because the samples taken are not always real averages. The true average should be established from scums taken from the waggons, together with any free juice which is often present. Again, the weight of the scums is often underestimated. Finally, the total amount of sugar, both soluble and insoluble, should be estimated.

2. Loss occurring in the filter-press cloths. This is by no means negligible, and should be ascertained by estimating the sugar absorbed by a single cloth. There are several ways of accomplishing this, although it is unnecessary to specify them here; but having regard to the large number of cloths employed, there is an aggregate loss in sugar which cannot be ignored.

3. Losses in the cloths of juice and syrup filters. The above observations apply here, especially in the case of syrup filters.

4. Losses in the condensation water. These are not negligible, having regard to the volume of the said water.

5. Losses from inversion during concentration. This loss varies with the duration of the heating, and with the various types of apparatus and the temperatures ruling.

6. Various mechanical losses. It is obvious that in every factory there is a loss in sugar, arising from the repeated manipulation of the materials. Sometimes it is a little juice or syrup which runs to waste; sometimes a little pulverized sugar is blown or swept away; or, again, some molasses is lost during weighing. The aggregate constitutes an appreciable loss, but one difficult to determine exactly.

7. Losses in the different heating appliances (*e.g.*, calorisators.) These are small as a rule, as they are generally noticed and provided for.

8. Losses during the boiling of second and third masse-cuites.

9. Losses owing to excess of sugar being sacked. This may amount to 100 to 150 grammes per sack, because in general the gross weight of the filled sack is, say, 101 kg., whilst the tare is only 850 to 900 grammes.

10. Losses through entrainment other than those referred to under (4). This constitutes the new source of loss in sugar factories.

If one inhales the vapour produced when heating a juice to boiling point or the vapour emitted by the juice issuing from the filter-presses a distinctly sweet taste is detected. We can easily prove the presence of sugar in the said vapour by the following method:—

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* Read at the Liège Congress.

Fill a perfectly clean glass with cold water and hold it over the issuing vapour; collect the condensed liquid in a glass and examine it by means of the alpha-naphthol and sulphuric acid test according to Pellet and Giesber's method. A very appreciable colour reaction will be obtained.

We carried out this experiment during the 1904-05 campaign, chiefly in cane sugar factories, having made one test in a French beet factory, and succeeded in detecting the presence of sugar in the vapour condensed from the atmosphere of the curing house. We then repeated the experiment with the vapour ascending from the defecators, and with that from the decantation tanks; and in each case sugar was detected.

We were able to estimate it. Sometimes a faint violet coloration was produced by a—naphthol, indicating merely 0·05 to 0·07% of sugar per litre of condensed liquid; sometimes, especially in the case of juice that had been heated to 83°-85°, we detected 0·25 to 0·51 of sugar per 100 cubic centimetres, equal to 2·6 to 5·1 gr. per litre.

Since a considerable quantity of vapour is continuously evolved, a constant loss of sugar must occur.

In the refinery we have also detected the presence of sugar in the liquid formed by condensing the vapours emitted by clarified filtered syrups and by the centrifugals. Unfortunately, however, we have not been able to make the same test on the vapours of the first and second carbonatation tanks, especially the latter.

We believe that there is here an appreciable loss of sugar, the more so since during the treatment of the juice a considerable amount of evaporation takes places. One can check this evaporation by analyzing the diffusion juice and the juice about to be evaporated, and by keeping a record of any water added in the milk of lime or for washing the scums.

We have often found an evaporation of from 3 to 4% of the total volume, and in some cases even more.

It should prove of interest to continue our experiments and to ascertain whether the sugar entrained is in the form of juice, or in a pure state. At present we think that it is entrained in the form of juice-vapour, or vesicles. Continued experiments should show us whether we have here a sensible loss that can be taken into account. Meanwhile, we may point out that if we heat a 10% sugar solution in an ordinary flask fitted with an outlet tube and then collect the condensed vapour, we cannot detect any sugar if we have taken care to prevent the entrainment of the boiling liquid. On the other hand, we have found sugar in the vapours of juice at a temperature of less than 70%, these vapours forming under the normal atmospheric pressure simply owing to the agitation of the liquid. It is evident that through this agitation a sort of pulverisation of the entrained juice takes place and this juice escapes condensation.

One can get an idea of this phenomenon by recalling what happens when hydrochloric acid is brought into contact with ammonia. The white vapours formed although in contact with water are not soluble therein, or only very slightly so, so that if a flask be filled with these vapours the latter can be decanted into another flask under water. One recovers the white fumes of ammonium chloride in the same way as one would decant a gas insoluble in water; and yet ammonium chloride is very soluble in water.

Whatever be its extent, the fact is undeniable that sugar is present in the vapours emitted by juices, syrups, &c., when cooling in open vessels at atmospheric pressure, and the experience of the last campaign has shown us the extent of the loss in terms of 100 gr. of sugar treated in the factory. We do not propose to discuss here the loss of sugar as powder when sifting, the losses occasioned by the mechanical carriage of the sugar to the store, &c., but it is conceivable that they are not beyond consideration.

In any case one cannot deny that there is still a source of loss, perchance a small one, which when added to others forms a total that is passed off as "undetermined or unknown" loss. A natural remedy, especially in cases where granulated sugar is dealt with, is to create a current of air which shall traverse the various passages in which the sugar is being handled and lead the scattered sugar to a layer of water.—(*Sucrerie Belge.*)

Editor's Note.—The loss of sugar here referred to by M. Pellet is of the same nature as that which occurs in the triple-effet and vacuum pan but on a much smaller scale. That such minute losses of sugar occur is an interesting addition to our knowledge, but remains of little value to the practical sugar maker.

SIMPLE CONTROL OF THE DISTILLERY WORKING WITH CANE MOLASSES.

By Manuel Elwart.

If there is an industry in existence where good luck counts for much, it is the production of alcohol from cane molasses. There is no control, no surveillance whatever, exercised in this part of the factory; accordingly when the price of alcohol is remunerative the proprietors lose a source of profit. It is for them and for their directors and factory managers that we have evolved the following simple method of control which allows them at any time of the day to test the working of the distillery in five minutes.

There is nothing scientific about our method, but it enables managers to use their eyes and see that here as in other industries chemical science is needful.

We have chosen a type of molasses which is very common, viz., one of 42·5° Bé. This is the density usually possessed by distillery molasses. As the methods of factory work are much the same in any one district, the total of sucrose and glucose varies very little. When the molasses is of a different density, it must be transcribed in terms of 42·5° Bé.

Table Showing the Volumes of Molasses at 42·5° Bé. in 1,000 Litres of Wash at 25° C.

Baumé.	Density.	Content in molasses. Litres.	Baumé.	Density.	Content in molasses. Litres.
2	1013	37·51	8·5	1060	144·50
3	1020	52·10	9	1064	154·90
4	1027	67·50	9·5	1067·7	163·60
5	1034	83·50	10	1071·5	172·20
6	1041	100·00	10·5	1075·2	181·30
7	1048·5	116·60	11	1049	190·50
7·5	1051·7	125·70	12	1084	206·30
8	1056	135·00			

Every day at a fixed hour the manufacturer should glance at the wash vats; he will see, for example, that six vats of 20,000 litres each have been distilled, and in measuring the products of the still he will note that 6,000 litres of absolute alcohol have been produced. On the other hand, he knows that the density of his wash is 10° Bé at 15° C. On consulting our table, he will see that 1,000 litres of such wash contain 172·20 litres of molasses at 42·5° B. and 25° C.

He then finds that: $\frac{6 \times 20,000 \times 172 \cdot 20}{1000} = 20,664$ litres of molasses yield 6,000 litres of alcohol, giving a return of $\frac{6,000 \times 1,000}{20,664} = 290 \cdot 30$ litres of absolute alcohol per 1000 litres of molasses.

This simple illustration of daily working will enable one to demonstrate the irregularity of one's returns and the necessity for introducing scientific methods so as to improve them.—(*Bulletin des Chimistes.*)

The Canadian Minister of Customs has decided that if molasses is not Muscovado molasses it is sugar; consequently, fancy molasses or syrup entering Canada is dutiable as raw sugar when tested over 52 degrees cane sugar.

Natal sugar, being prepared without the use of blood or animal matter, is likely to find an increasing market in India, where the religious scruples of the people have resulted in a campaign against ordinary imported sugar.

CONSULAR REPORTS.

France.

Marseilles.—The British Consul-General in his Report for 1905 writes:—

The suppression of bounties on sugar, causing a fall in price of 60 per cent. to the advantage of the consumer, which had already shown good results in the last four months of 1903, brought about a remarkable increase in local consumption, estimated at over 30 per cent.

The grower of beetroot having refrained from excessive planting, the accumulated stocks gradually became absorbed. This brought about a rise in prices; but another cause, the drought of the spring and summer of 1904, reduced the European production from 5,655,000 tons in 1903-04 to 4,626,000 tons in 1904-05.

The French crop fell from 760,000 to 581,000 tons, and white sugar (No. 3), valued at 23 fr. 95 c. in February, 1904, reached 41 fr. 43 c. in December.

French consumption of sugar increased by 16·40 per cent. as compared with 1903 and 32·20 per cent. in comparison with 1902.

French exports reached 285,393 tons as against 212,368 tons in 1903, an increase of 34 per cent. Unfortunately Marseilles during 1904 benefited in no way by this increase. The refined sugar exported amounted to 67,466 tons in 1903 and 61,962 tons in 1904. The local refineries supplied to local consumers 58,000 tons in 1904, almost similar to the quantity supplied in the preceding year.

This slowing off in local activity could not be attributed to any want of initiative on the part of the Marseilles merchants and manufacturers. It was due solely to the strikes which, on several occasions, suspended all commercial activity here; one of the Marseilles sugar refineries had even to close their works for 40 days, owing to the utter impossibility of importing or carting their raw material and of exporting their refined sugar.

The cessation of the Marseilles epidemic of strikes brought about a remarkable activity during 1905, and at the present moment (in January, 1906) the Marseilles refiners cannot fill half their orders.

At the beginning of 1905, as prices rose, there was little buying; but on the depletion of stocks buying began again with the increasing demand for sugar from Asia Minor and the Persian Gulf.

Marseilles, owing to the disturbed condition of Russia, has taken her place in supplying Asia Minor and the Persian Gulf. Having now got in on those markets, Marseilles exporters hope to keep their hold on them at the expense of Russia.

The demand for sugar in Morocco is on the increase, as the disturbed condition of affairs in that country has, strange to say, only increased the demand for sugar. More tea is apparently drunk there now than before the rebellion.

RUSSIA.

Warsaw.—The British Consul-General writes:—Although the area under beet in 1905 was 2,033 acres, or 1·3 per cent. less than the average for the last five years, the crop was 4,800,607 cwts. more than the average yield for the same period.

The quality of the beet, though not so good as in 1904, was also above the average for the last five years by 0·76 per cent., so the year may be considered an exceptionally good one for beet cultivation.

The quality would no doubt have been even better had it not been for excessive rain, which fell in the latter half of the year.

In several places carters went on strike, thereby interfering with field work, as a certain quantity of beet was thus exposed to the influence of the weather. The railway strikes also had a bad effect on the transport of beetroot, which was in many cases detained in trucks. On the whole, however, the damage caused by the strikes was inconsiderable.

In sugar factories, of which 49 were working in this district in 1905, the stoppage of work was a more serious matter, and it was found necessary to raise wages 20 per cent.

They nevertheless carried on a very profitable business, and paid the highest dividend known in the last 50 years. Of course, as is always the case, the large factories did better than the small ones.

Exclusive of four factories, from which no estimates have been received, it is estimated that the output of sugar during the current season will be about 9,400,000 pouds (3,100,000 cwts.).

The excise duty is 1 r. 75 c. per poud (11s. per cwt.), but a bounty of the same amount is paid on exported sugar, or in other words the excise is refunded. The quantity of sugar allowed to be exported is fixed by the Government.

Manufacturers are only allowed to sell for home consumption a certain amount of their produce, and a quantity has to be kept in stock. When prices rise, the Government orders this reserve to be put on the market.

According to official statistics, about 766,626 cwts. of Russian sugar, mostly from Poland, were exported through the port of Dantzig by the Vistula and by rail, during the past sugar campaign, from August 1st, 1904, to July 31st, 1905. In comparison with the foregoing season, the export was less by 422,347 cwts., or by 35 per cent.

Instead of the markets it has lost, Russian sugar exported through Dantzig has found new ones, such as Norway, Sweden, Portugal, Turkey, and, it is said, Switzerland, to which countries the total consignments amounted to some 266,666 cwts.

One factor which may lead to a rise in prices is the question of sowings in 1906. It may be expected that the area under beet will be increased should the country be free from disturbances, as generally happens in years following those in which the quantity or quality of beet yield has been good; the former having been the case in 1905. At the present moment, however, the fear of agrarian disorders renders the manufacturers disinclined to grant the usual advances, either in money or seed, to the growers. Should these disorders continue, there can be no doubt that they will have a very unfavourable effect on the sowings in the coming year; and, combined with an immunity from the restraining and regulating influence of the sugar issues from the reserves, will give speculators an opportunity of raising prices.

Another industry to which the beet crop is of importance is the manufacture of artificial food for cattle, which is an entirely new industry in the Russian Empire, and is, therefore, worthy of general attention. This is all the more the case from the fact that the question of food is the weak point of Russian cattle-farming and agriculture. The decline of Russian cattle-farming is generally admitted to be chiefly due to the insufficiency and inferior quality of food-stuffs.

In 1900, in the districts where the harvest was a failure, fresh fodder was also lacking, and the supply of artificial food became a question of grave importance. The want of such food cannot be ascribed to lack of material but to want of enterprise on the part of the people and to their supineness. It may be mentioned, as an instance of this, that the sowing of grass for hay is practically unknown, although a crop artificially sown is better both in quality and quantity than natural hay.

Practically no use is made in this country of such valuable material for fodder as wheat and rye, bran, sunflower and hemp refuse; all these are, nevertheless, extensively exported. Still less is refuse matter of technical production, such as molasses, malt, &c., utilised. These, in their raw state, have the disadvantage of containing too much liquid and of being incapable of being long preserved; mixed with other materials, however, they form most excellent food, the refuse of sugar being especially valuable.

Manufactories of cattle food in the United Kingdom, France, and Germany employ large quantities of Russian molasses for purposes of their production, and a considerable amount made of Russian raw material is sent back to Russia in the form of cattle food. The richer class of stock owners, who are the chief purchasers, have to pay the cost of transport, duty, and agency fees, in addition to the high price of the food.

Under these circumstances, special interest must be attached to the first artificial cattle food factory in the Empire, just started near

Warsaw by an Austro-Polish company, which is, therefore, the pioneer of an industry capable of great expansion in Russia.

As molasses will be principally used in the manufacture of the special food made by this factory, there will be no difficulty in obtaining material from the local sugar refineries.

The existence of 87·91 per cent. of nourishing substance, which an analysis of this food reveals, puts it on a level with compressed grain foods, and there are, moreover, only 9·77 per cent. of substances which cannot be assimilated, whilst in oats there are 21·71 per cent., in wheat bran 24·55 per cent., and rye bran 25 per cent.

The price of the food made in this factory is at present high, but the directors explain that it will vary in accordance with the market price of the dearer ingredients, as for instance, bran, and that a poud (36 lbs. English) will always be from 15 to 20 c. (4d. or 5d.) cheaper than the same weight of oats.

It is stated that the proper amount to be given daily is 8 lbs. per 10 cwts. of live weight.

UNITED STATES.

The amount of sugar imported from Cuba in 1905 was 1,092,180 tons, valued at $72,649,818. In 1904 the amount imported was 1,151,345 tons, valued at $55,357,309.

According to a well-known authority, the consumption of sugar in 1905 decreased 139,946 tons, or 4·896 per cent., against an increased consumption in 1904 of 8·531 per cent.

The total refined sugar consumption in 1905 was 2,506,680 tons, of which the Sugar Trust supplied a little over one half.

The following shows the percentage of sugar supplied during the last two years :—

	1904. Per cent.	1905. Per cent.
Sugar Trust	58·07	52·89
Independent refiners	35·19	37·48
Domestic beet factories	6·48	8·79
Foreign refined	0·26	0·84

The average difference in price between raw and refined sugar in 1905 was 0·978 c. per lb., against 0·798 c. in 1904.

The consumption per head in 1905 was 70·5 lbs.; in 1904 it was 75·3 lbs.; in 1903, 72·8 lbs.; in 1902, 69·7 lbs.; and in 1901, 66·6 lbs. In 1885 it was 51 lbs.

The Syndicate of French Sugar Factories, at 42, Rue de Louvre, Paris, are offering a prize of 100,000 francs for the best scheme for the utilisation of sugar for industrial purposes other than for foodstuffs. The competition will be open to foreigners.

PUBLICATIONS RECEIVED.

The Liverpool University INSTITUTE OF COMMERCIAL RESEARCH IN THE TROPICS, of which Sir Alfred L. Jones, K.C.M.G., is Chairman of the Council, issue a QUARTERLY JOURNAL, giving a record of their work.

From it we learn that the objects of the Institute are as follows:—(1) Collecting and tabulating all kinds of information regarding raw products, natural resources, trades, industries, and economic conditions, which can be of service either to commerce or to science; (2) studying the botany, zoology, geology, ethnology, meteorology, and physiography of tropical countries, more particularly in their relation to the development of British commerce; (3) investigating all kinds of scientific problems which arise in connection with trade and industry: (4) training experts in the various branches of applied science concerned; and (5) supplying scientific information and advice to all interested in commerce. The means adopted to effect these objects are:—Scientific and exploratory expeditions; the establishment of a bureau in Liverpool where the latest scientific and commercial information may be obtained; research work in the laboratories of the City and of the University by a staff of experts; the preparation and publication of reports, returns, pamphlets, and monographs, and the delivery of lectures and addresses; correspondence and exchange with Government departments and learned societies, both at home and abroad.

The contents of the current number are varied, and include some notes on insect pests. As a whole the Journal is well got up, but it would be the better for a contents list if not an index as well. The price is 2s.

MODERN SUGAR MILLS.—A large and well-produced catalogue issued by Messrs. Manlove, Alliott & Co., Engineers, of Nottingham. There is no letterpress description, but the numerous plate illustrations of mill types form a pleasing collection. The same firm issues a reprint of the article "A Nine-roll Sugar Cane Crushing Mill" which appeared in the *Engineer* a short while ago.

The quantity of raw sugar produced in Germany from 1st September, 1905, to February 28th, 1906, was 2,068,211 metric tons, as compared with 1,333,279 metric tons during the corresponding period of 1904-05. The figures for refined sugar were 903,019 and 786,043 metric tons respectively.

IMPORTS AND EXPORTS OF SUGAR (UNITED KINGDOM

To end of March, 1905 and 1906.

IMPORTS.

Raw Sugars.	Quantities.		Values.	
	1905. Cwts.	1906. Cwts.	1905. £	1906. £
Germany	607,554	2,527,600	443,165	1,068,842
Holland	74,293	35,033	54,731	13,143
Belgium	265,061	185,899	199,926	75,720
France	25,355	151,957	20,027	65,220
Austria-Hungary	183,215	101,655	136,217	42,255
Java	884,008	87,958	670,985	41,451
Philippine Islands	....	....	....	....
Cuba	....	111,910	....	41,943
Peru	437,122	191,454	333,171	90,520
Brazil	23,283	555,566	15,607	213,296
Argentine Republic	....	....	....	....
Mauritius	45,013	30,769	26,401	12,068
British East Indies	3,977	....	3,390	....
Straits Settlements	58,132	18,082	30,590	7,882
Br. W. Indies, Guiana, &c.	334,637	370,403	295,034	220,777
Other Countries	288,223	26,156	220,071	12,587
Total Raw Sugars	3,229,873	4,394,442	2,449,315	1,905,704
Refined Sugars.				
Germany	2,204,897	2,602,497	1,908,831	1,485,522
Holland	387,259	696,632	342,977	415,213
Belgium	89,038	80,493	78,243	47,138
France	223,145	563,138	198,492	310,646
Other Countries	161,568	10,014	134,705	5,041
Total Refined Sugars	3,065,907	3,952,774	2,663,248	2,263,560
Molasses	522,876	662,938	116,004	133,792
Total Imports	6,818,656	9,010,154	5,228,567	4,303,056

EXPORTS.

British Refined Sugars.	Cwts.	Cwts.	£	£
Sweden	50	127	48	114
Norway	6,137	4,398	5,217	2,708
Denmark	17,392	19,798	14,155	10,098
Holland	19,365	20.574	16,733	12,096
Belgium	1,148	2,442	910	1,283
Portugal, Azores, &c.	4,089	10,815	3,367	5,863
Italy	16	11,705	16	6,162
Other Countries	46,057	150,666	44,876	95,942
	94,254	220,525	85,322	134,266
Foreign & Colonial Sugars.				
Refined and Candy	4,435	3.349	4,404	2,464
Unrefined	10,933	52,536	8,999	28,036
Molasses	240	4,710	101	1,475
Total Exports	109,862	281,120	98,826	166,241

UNITED STATES.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1906. Tons.		1905. Tons.
Total Receipts Jan. 1st to April 19th	595,200	..	647,079
Receipts of Refined ,, ,,	525	..	383
Deliveries ,, ,,	602,872	..	625,073
Consumption (4 Ports, Exports deducted) since January 1st	485,150	..	458,875
Importers' Stocks April 18th	30,861	..	22,006
Total Stocks, April 25th	325,000	..	284,330
Stocks in Cuba, ,,	280,000	..	349,500
	1905.		1904.
Total Consumption for twelve months	2,632,216	..	2,767,162

CUBA.

Statement of Exports and Stocks of Sugar, 1905 and 1906.

(Tons of 2,240lbs.)	1905. Tons.		1906. Tons.
Exports	473,634	..	377,691
Stocks	319,320	..	265,316
	792,954	..	643,007
Local Consumption (three months)	11,930	..	12,075
	804,884	..	655,082
Stock on 1st January (old crop)	——	..	19,450
Total Production	804,884	..	635,632

Havana, March 31st, 1906.

J. Guma.—F. Mejer.

UNITED KINGDOM.

Statement of Imports, Exports, and Consumption for Three Months ending March 31st.

	Imports.					Exports (Foreign).				
Sugar.	1904. Tons.		1905. Tons.		1906. Tons.	1904. Tons.		1905. Tons.		1906. Tons.
Refined	192,710	..	153,295	..	197,639	321	..	222	..	167
Raw	170,676	..	161,494	..	219,722	1,174	..	547	..	2,627
Molasses	16,247	..	26,144	..	33,147	2	..	12	..	235
Total	379,633	..	340,933	..	450,508	1,497	..	781	..	3,029

	Home Consumption.				
	1904. Tons.		1905. Tons.		1906. Tons.
Refined	203,712	..	147,012	..	188,572
Refined (in Bond) in the United Kingdom	124,153	..	115,729	..	140,223
Raw	26,548	..	18,977	.	30,473
Molasses	20,495	..	26,621	..	31,738
Molasses, manufactured (in Bond) in U.K.	16,611	..	14,296	..	18,039
Total	391,519	..	322,635	..	409,045
Less Exports of British Refined	6,588	..	4,713	..	11,026
Total Home Consumption of Sugar	384,931	..	317,922	..	398,019

STOCKS OF SUGAR IN EUROPE AT UNEVEN DATES, APRIL 1ST TO 21ST, COMPARED WITH PREVIOUS YEARS.

IN THOUSANDS OF TONS, TO THE NEAREST THOUSAND.

Great Britain.	Germany including Hamburg.	France.	Austria.	Holland and Belgium.	TOTAL 1906.
163	1402	707	666	259	3198

	1905.	1904.	1903.	1902.
Totals	2180 ..	2844 ..	2763 ..	2899

TWELVE MONTHS' CONSUMPTION OF SUGAR IN EUROPE FOR THREE YEARS, ENDING MARCH 31ST, IN THOUSANDS OF TONS.

(Licht's Circular.)

Great Britain.	Germany.	France.	Austria.	Holland, Belgium, &c.	Total 1905-06.	Total 1904-05.	Total 1903-04.
1694	969	613	496	178	3951	4102	3873

ESTIMATED CROP OF BEETROOT SUGAR ON THE CONTINENT OF EUROPE FOR THE CURRENT CAMPAIGN, COMPARED WITH THE ACTUAL CROP OF THE THREE PREVIOUS CAMPAIGNS.

(From Licht's Monthly Circular.)

	1905-1906. Tons.	1904-1905. Tons.	1903-1904. Tons.	1902-1903. Tons.
Germany	2,425,000 ..	1,598,164 ..	1,927,681 ..	1,762,461
Austria	1,510,000 ..	889,373 ..	1,167,959 ..	1,057,692
France	1,085,000 ..	622,422 ..	804,308 ..	833,210
Russia	1,000,000 ..	953,626 ..	1,206,907 ..	1,256,311
Belgium	330,000 ..	176,466 ..	209,811 ..	224,090
Holland	210,000 ..	136,551 ..	123,551 ..	102,411
Other Countries .	410,000 ..	332,098 ..	441,116 ..	325,082
	6,970,000	4,708,758	5,881,333	5,561,257

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☞ The Editor is not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

NOTES AND COMMENTS.

Hawaii.

The 1905 Hawaiian crop which totalled 426,248 short tons was the second largest crop which the islands have ever produced. Of this 299,843 tons were produced by irrigation, and 126,405 tons by natural rainfall. The output by irrigation is steadily on the increase. While the prices at the beginning of 1905 pleased everybody, the present prices barely enable the planters to cover expenses. In fact, the Hawaiian sugar industry is in a bad way owing to the great shortage of labour. The American Government, we learn, seem determined to have these islands Americanized, and the entry of Asiatic labour is being discouraged. Consequently very few Japanese are now coming in; and there is a great exodus of those who are already there to the mainland. Having regard to this, the future prospects of the sugar industry in the Hawaiian Islands cannot be considered satisfactory. In fact, there is a tendency on the part of planters to abandon tracts of sugar land, and in some cases to leave the Islands.

The Market for Cuban Sugar.

Mr. Hugh Kelly, head of the well-known New York firm of Hugh Kelly & Co., has been expressing his opinion in the *Cuban Review* regarding the Cuban sugar market and its relation with the United States. He thinks the supposed reciprocity is a fraud, as with the prices ruling the advantages are almost entirely lost to the Cuban producer. In his view there are three standards of price in the New York sugar market. (1.) The world's price as governed by Hamburg beet. (2.) The U.S. price for Cuban sugars. (3.) The price for non-favoured sugars, which is $\frac{5}{16}$c. per lb. less than for Cuban sugars, no matter what figure the latter be. Thus they have simultaneously German beet offered at 8s., equal to 3·64c. duty paid; Cuba centrifugals 96° test selling at 2c. c.f., equal to 3·36 duty paid; and non-favoured West Indian cane at 1$\frac{1}{16}$c. c.f., put on same parity as the Cuban sugar. The latter have, it will be seen, lost four-fifths of all their reciprocity advantages.

Mr. Kelly thinks the main reason for this is that Cuba persists in marketing within four months a quantity of sugar which should be spread over at least eight months, say from January 1st to August 1st of each year. For this purpose, Cuba's most pressing need is a system of warehousing and finance such as will enable her to dispose of her crop not as she manufactures it, but as it is needed for consumption.

The French "taxe de raffinage."

Article 15 of the French Budget Law for 1906 provides that from the 1st September, 1906, the "refining tax" on sugar is to be reduced from 2 frs. to 1 fr. per 100 kilogs. of refined sugar. This, known as the "taxe de raffinage," was originally levied to provide funds for the "direct bounty." It was practically a mere increase in the consumption tax, and to represent it as a tax on refining was a mere sham. It was reduced from 4 fr. to 2 fr. when the consumption duty was reduced. It was not abolished because the French Government said they wanted funds to provide for the "détaxe de distance." Now finding that 2 fr. is too much for this purpose they have reduced it to 1 fr. The French consumer, therefore, pays 25 fr. + 1 fr. = 26 fr. duty on his refined sugar if he buys it in the form of loaf. But if he buy white crystals from the beetroot factories, he only pays a duty of 25 fr.

The Canadian Tariff on Molasses.

The Customs at Ottawa have been giving a detailed explanation of their differentiation of molasses. They hold that molasses which is entitled to a free entry into Canada must be a by-product of muscovado sugar, and that so-called fancy molasses is a different article and is not entitled to free entry.

> "The polariscopic test of molasses to ascertain the percentage of cane sugar is by Clerget's method, and not by direct polarization. This system has been adopted by the Department, and has been in force since March, 1904, under the authority of Section 9 of the Customs Tariff, 1897.

> "It is considered that the limit of 52° cane sugar (by Clerget's method) will cover all genuine molasses from Barbados. All samples are to be tested here, and any samples of genuine muscovado molasses found to test over 52° cane sugar will be specially considered.
>
> "Samples of West Indian molasses have not been tested here for some time, but it is found necessary to resume the test for classification purposes. A sample of a recent importation from the West Indies shows no cane sugar, and is therefore dutiable at 3c. per lb. under Tariff item 440."

The latest information is that genuine muscovado molasses from British West Indies is admitted free regardless of test. Fancy molasses from same source testing not more than 52° (Clerget) is also admitted free. But fancy molasses testing over 52° is dutiable about 4c. per imperial gallon.

The Sugar Beet.

Our American contemporary, *The Sugar Beet*, announces that in future, beginning July 1st, it will appear as a Quarterly; at the same time it will discard the special news features and other characteristics of trade journalism for which some American papers are noted—we might almost say notorious. The new issue will partake of a technical character, and will deal exclusively with the scientific side of sugar beet growing and manufacture. We have always thought that the *Sugar Beet* under the admirable editorship of Mr. Lewis Ware deserved better support than it seems to have secured. We are sure, however, that under its new form it will gain a wider circle of readers, and we shall welcome its appearance.

Canadian Beet Sugar.

The *Financial News* says that the Premier of Alberta has introduced a Bill which proposes to assist the establishment of the sugar beet industry in Alberta by bonusing the finished product. The Bill proposes that the sum of $250,000 of Government Funds be set aside to be used in fostering the industry, the distribution of which will extend over five years at the rate of $50,000 a year for the first two years. Any manufacturer who produces a standard grade of refined sugar will receive a bonus of one-half cent per pound for the first two years, and for the following three years one quarter of a cent. The farmer is protected in the assurance of his share of the industry, which requires payment for beets on the basis of the amount of saccharine matter contained in the product.

MR. LLOYD-GEORGE, M.P., ON SUGAR.

In two former articles* we examined, with considerable thoroughness and detail, the principal errors into which the opponents of the Sugar Convention have been led by the writers of economic fiction. We showed that the Convention was a sound and necessary free trade measure—necessary in the interests of the consumer no less than in those of the producer—in fact, as M. Yves Guyot has declared, "the most important achievement of economic liberal policy in Europe since the signing of the Commercial Treaties of 1860."

We pointed out that the price of sugar had remained for nearly a year after the Convention came into force considerably below the cost of production, and that the temporary and violent rise in price which subsequently took place was clearly the result of a sudden loss of more than a million tons in the supplies, owing to the partial failure of the beetroot crop. This rise was, therefore, the result of bounties, not of their abolition, because bounties had stimulated the production of beetroot sugar to such an extent that the world had become dependent on that crop for two-thirds of its supply. A deficient beetroot crop consequently always causes a considerable rise in the price of sugar. One of the main objects of the Convention is to remedy this artificial state of things, in the interest of the consumer no less than of the producer.

To obtain the assent of the Contracting Parties to the abolition of bounties, it was essential that they should have some guarantee that their sugar should no longer have to contend in British markets against bounty-fed competition. Hence the absolute necessity for a penal clause. But we have clearly proved that that clause is no detriment to the consumer because the price of sugar in this country is always the world's price, and that price is governed by the quantity of sugar produced throughout the world, wherever that sugar may go. The world's price—and therefore our price—falls when the world's production exceeds its consumption, and rises when its consumption exceeds its production. If the Russian bounty continues to stimulate over-production, the world's price—and therefore our price—will be affected just the same, whether Russian sugar comes to England or goes elsewhere. The British consumer will, therefore, reap the same benefit in either case from any fall in price arising from excessive production in Russia.

We have also shown the absolute fallacy of the assertion that if there had been no Convention we should be still enjoying the abnormally low prices of 1901-2. Those prices were more than 3s.

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* "The Sugar Convention as a Party Cry," January, 1906.
"Sugar in Parliament," May, 1906.

per cwt. below the cost of production, and we have pointed out that if they had continued until now, the producers of sugar throughout the world would have disbursed £82,500,000 out of their own pockets in order to enable consumers to continue to enjoy the questionable benefit of buying a commodity 3s. per cwt. below the cost of production. The sugar producers—not possessing that sum of money—would long before now have ceased to produce, and the consumer would have been told by his grocer that sugar had almost disappeared from the market.

The injury to the confectioners has turned out to be pure fiction. For nearly a year after the Convention came into force they had the exceptional advantage of sugar below cost price. When the short crop raised prices during the greater part of 1905, we are told by their own official report that they had a particularly good time, exports increased by 73,351 cwts., and there was "an even greater improvement in the home trade." A similar increase has taken place in the first three months of the present year. They *must* have flourished while sugar was below cost price; they tell us they flourished during the short period of high prices. Whence, then, can their grievance come?

We briefly recapitulate these points in order to be able to deal with Mr. Lloyd-George's speech of March 27th without arguing again matters already conclusively settled.

At the outset of his speech, Mr. Lloyd-George loudly repudiates the idea that the present Government have not mastered the subject of the Sugar Convention. He is ready to take his stand on the accurate knowledge of the whole subject which they have acquired by the most careful investigation. "We have never said," he cries, "that we have not considered the merits of the Convention." Very well; let us see then, from a careful analysis of his speech, the nature of this profound insight into the details of a somewhat difficult subject: let us lay bare before the public "the mess" into which he declares the late Government have "landed him."

The first sin of the Convention he describes to be that whereas prices previous to it were "very steady," since it came into force they have been violently fluctuating. He regards the figures of 1901-2, which were 3s. per cwt. below cost price, "very steady." Most people engaged in the practical work of sugar production and its markets regard such prices as anything but "steady." But Mr. Lloyd-George, not being accustomed to industry and commerce, takes a different view. He is astounded that we do not "go down again to the old figures of 5s. 9d. or 6s." It is the wicked Convention he says that prevents us. It never occurs to him that sugar producers are not prepared, even without a Convention, to present the consumers of the world with 3s. per cwt. out of their own pockets. As we have shown, it would have taken, even without a Convention, £82,500,000 to enable them to do it. This is Mr. Lloyd-George's political economy.

That the rise of price inevitably involved in a sudden deficiency of more than a million tons in the beetroot crop was caused entirely by the Convention he has no doubt whatever. This is one result of his careful study of the question. Another is that because sugar is now only a shilling a hundredweight below cost price "we do not get the benefit of natural price." In his opinion the price of 6s. per cwt.—that is 3s. per cwt. below cost—was "a natural price," but now that producers are selling at 8s. 6d. and only losing 1s. per cwt. the price is altogether artificially high. Let him ask the German manufacturers what they think of present prices. But a still more fallacious idea comes on the top of this. The unnatural price of 8s. 6d. is caused because "we are excluding all the produce of a country like Russia—something like 1,000,000 tons a year." Therefore in Mr. Lloyd-George's opinion the unnatural price is only in this country. Those million tons of Russian sugar must be knocking down prices to the "natural" level in the rest of the world. This he does not explain, and he is evidently unaware that 8s. 6d. is the price—at the present moment gone down below 8s.—not in England only but everywhere else, because it is the price free on board Hamburg, from whence sugar is shipped to all parts of the world and comes into competition with the Russian sugar—not with a million tons of it as Mr. Lloyd-George wants us to believe, because Russia consumes the greater part of that herself, and at the moment when his speech was made only had about 170,000 tons of surplus stock, hardly enough for her ordinary export demand.

Thus we see how easy it is for a statesman to master an industrial and commercial question in a somewhat erroneous way. His information has not been altogether first-hand. If he believes all this he ought not to lose a moment in denouncing such a mischievous international arrangement. The late Government, he complains, "have got us into this pickle" and his business is to get out of it. Let us go down again to 6s. per cwt. and ruin all the sugar production of the world. That is how to bring real and permanent benefit to the down-trodden consumer who is now getting his sugar only 1s. per cwt. below cost price. We have "entered into a Convention to run up prices" and that is the result, only a miserable shilling below cost price. No wonder "the poorest of the poor" are feeling the blow which "presses hardest on the industrial classes with real and crushing severity." So says Mr. Paul. How about the industrial classes who have to produce below cost price?

Our West Indian Colonies were unfortunate in having a short crop just at the moment when Europe had such a deficient harvest that prices for a few months rose considerably. In his study of the subject

Mr. Lloyd-George has failed to ascertain this fact. He therefore points the finger of scorn at the poor West Indies, and says, "this is the great policy which was to regenerate the West Indies and give cheap, certain sugar without fluctuations." No one has told him, in the course of his studies, that increased acreage and new factories do not and cannot spring up in a moment. The reduced quantity they sent in was the result of a bad crop; the high price was the result of a loss of a million tons in the beetroot crop; and that rise in price was owing to the world's dependence for two-thirds of its sugar on a crop stimulated to that enormous size by bounties. That will be remedied, but not in such a hurry as Mr. Lloyd-George supposes.

All these misleading statements are well enough for a party pamphleteer; but when a Cabinet Minister, specially responsible for the policy he is criticising, transfers them to his speech we are justified in using very plain language with regard to them. Ministers are bound to obtain reliable information before committing themselves to views which are certain to be exposed as unfounded delusions if they are not sound. With this apology for our frank contradictions we will continue to examine the speech.

A little further on Mr. Lloyd-George gives the figures of the deficient crop in the West Indies, well known by every one in the industry to be deficient owing to having a bad season—228,000 tons against 253,000 tons—and exclaims "that is the result of the Sugar Convention on the West Indies." These are the words of a responsible Minister of the Crown, but they sound more like those of an electioneering tout. Surely we have left all that behind us and ought to be occupied now in ascertaining a few real facts for our guidance in the future. He adds that "this great scheme of fiscal reform benefits every foreigner in Europe, benefits every colonial possession except our own, and actually reduces the production of our colonies by 20,000 tons." A sentence fairly compact of inaccuracies. As to the foreigner in Europe, the German producer, who can produce cheaper than any one in Europe, is crying out loudly because he cannot go on producing below cost price. Producers in the tropics, as Mr. Lloyd-George had just explained, were developing their production for other reasons; and the West Indies were simply suffering from a bad crop. They are, as every one knows, extending their acreage and building new factories in spite of the present low price of sugar.

Then the speaker goes back to the European beetroot crop and combats an imaginary assertion that its production had gone down. It is true the assertion was made—by the opponents of the Convention. They said the high prices of 1905 were caused, not by the drought but by the short sowings. We showed that the sowings were actually rather in excess of the year before so far as Germany, Austria, Belgium and Holland were concerned. But Mr. Lloyd-George quotes the production of the following year, 1905-6, which gave 6,800,000 tons. He does not mention that the high prices in the winter and spring of 1905, caused by the bad crop of 1904-5, stimulated the beetroot industry to sow the largest acreage on record. Hence the big production and the low prices. Statesmen seem to disregard simple explanations like these.

This leads him to his great peroration. "But the worst of it is that while cane production is growing in every colony except ours, and beet production is growing enormously, we are not getting the full advantage of it. Why is that? We are told that the Convention did not interfere. What did interfere? The Convention must have had the effect of arresting the decline in the price of sugar which had been going on steadily." Yes, for once we agree with Mr. Lloyd-George, but he is evidently quite unaware of the real explanation. Prices are governed by two things, production and consumption; and production is governed by the cost of production. If we went down, as Mr. Lloyd-George desires, "to the old figures of 5s. 9d. and 6s.," production would rapidly decline and prices would jump up. What keeps prices at 8s. now—still a ruinous price—is the great increase in the consumption of the world. The Convention has contributed to this by enabling some European countries to reduce their consumption duties, and by compelling them to reduce their protective import duties. Let Mr. Lloyd-George tell us whether he objects to an increase of consumption and to a reduction in foreign protective import duties. When he has answered that question we will pursue the subject further.

There can be only two reasons why the present Government object to the policy of the Sugar Convention. They must either be of opinion that it is contrary to free trade, or that it prevents consumers from enjoying such low prices as they would otherwise have. The first view would mean that they are in favour of protection to foreign producers on British markets; the second is equivalent to denying that the persistent sale of a commodity below cost price reduces production, ruins the natural producer and raises the price.

This analysis of Mr. Lloyd-George's speech gives rise to one inevitable reflection. The Government must be either wilfully misrepresenting facts or culpably ignorant of matters they have undertaken to administer. For an opposition misrepresentation may lead to temporary triumph, but for a Government it can only bring disaster; so also will ignorance of the duties they are called upon to discharge, and the real facts with which they have to deal.

RETAIL PRICES OF SUGAR.

The following Board of Trade Return shows the price per pound retail of the kind of sugar, whether refined or unrefined, most largely consumed by the working classes in London, Paris, and Berlin, at the 1st day of March, 1903, 1904, 1905, and 1906, together with the amount per pound, in English currency, of the customs and excise duties respectively in each case.

[NOTE.—*The prices given in this return are the prices of the kind of sugar most largely consumed by the working classes in each capital. It is not to be understood that the prices refer to a uniform grade of sugar in the three capitals.*]

	Retail price of Sugar at March 1st.			
	1903.	1904.	1905.	1906.
London :	d. per lb.	d. per lb.	d. per lb.	d. per lb.
Retail price	1¾	1¾	2¾	2
Customs duty	0·45	0·45	0·45	0·45
Excise duty	—	—	—	—
Paris :				
Retail price	4¼	3	3½	3
Customs duty‡	3·23*	1·44*†	1·44*	1·44*
Excise duty	2·79*	1·18*†	1·18*	1·18*
Berlin :				
Retail price	3¼	2¾	2¾	2¼
Customs duty‡	2·18	1·02†	1·02	1·02
Excise duty	1·09	0·76†	0·76	0·76

German statisticians give this year's area of beets as 1,805,362 hectares as compared with 1,901,610 in 1905 and 1,626,942 in 1904.

The Brussels Commission, as a result of its sitting last month, has decided that there are no longer any grounds for maintaining the additional duty on Brazilian sugar as fixed at the sitting of October last. This means that this sugar will continue to secure free entry into the United Kingdom.

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* Including also the "*taxe de raffinage*," levied equally on imported sugar and on sugar of home production.

† In force from 1st September, 1903.

‡ In France and Germany, imported sugar is subject to excise duty in addition to import duty proper. The "Customs duty" stated above for these countries includes the total amount of duty payable on importation—*i.e.*, it includes both import and excise duty.

SIMPLE METHODS OF CHEMICAL CONTROL.

By T. H. P. HERIOT, F.C.S.

(Continued from page 192.)

XI.

THE CONTROL OF THE JUICE.—(Continued.)

Having measured the volume of the juice and ascertained its composition by chemical analysis, we are now in a position to draw certain practical conclusions.

PERCENTAGE OF JUICE ON CANES.

The weight of juice extracted per 100 parts of canes is not a true measure of the work done by the mill as is too often supposed, and is of little value in the control unless the percentage of fibre in the megass be also determined. The latter operation lying somewhat outside the scope of the present series of papers, we selected the moisture test* as an approximate guide to the mill work when no maceration water is added.

Nevertheless, the percentage of juice on cane is too familiar a figure to be wholly ignored and is frequently of interest in comparing the yields of juice from different varieties of cane, or from the same variety when grown on different soils. This simple calculation should therefore be made wherever the canes can be weighed with a fair degree of accuracy.

As an example, we will take the figures on the first line of the accompanying record, namely, 298·5 tons of canes and 40,600 gallons of juice at 18·0 Brix. In Table I. (Chapter V.) it will be seen that, at 18·0 Brix, 209·2 gallons of juice weigh one ton. Hence $\frac{40600}{209{\cdot}2} = 194{\cdot}1$ tons (as recorded in the third column of record), and this weight of juice being extracted from 298·5 tons of cane corresponds to a yield of $\frac{194{\cdot}1 \times 100}{298{\cdot}5} = 65{\cdot}0\%$, leaving a balance of 35·0% of megass.

INDICATED SUGAR.

Assuming that the loss of sugar in the megass has been minimised as far as possible, we may now take stock of the sugar entering the factory in the form of juice.

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*Described in Chapter VIII.

In addition to the data given in the last chapter, we will assume, by way of example, that 58 clarifiers have been filled during the day's work, giving a total volume of 58 × 700 = 40,600 gallons of juice. A mixed sample (collected from each of the 58 clarifier tanks) was found to contain 1·533 pounds of sucrose per gallon, when examined by the polariscope. Combining these two measurements, we learn that 40600 × 1·533 = 62240 pounds of sugar have entered the factory during the day.

In arriving at this result we have required neither theories nor suppositions, but have relied upon actual measurements and the multiplication table.

AVAILABLE SUGAR.

By this is meant that proportion of the total indicated sugar which can be crystallized and thereby rendered *available* to the sugar producer.

Now as the actual yield of crystallized produce varies with the purity of the juice, the efficiency of the factory appliances, and the skill of the pan-boiler, it is convenient to regard the available sugar as a theoretical yield obtainable only under the most favourable conditions. It thus follows that the *actual yield* will fall short of the *theoretical yield* (available sugar) in all but the most up-to-date factories.

Dr. Winter, of Java, has devised a formula for calculating the available sugar when the purity of the juice is known. Whereas this formula was based on actual yields obtained in modern factories, it is of interest to state that a similar conclusion was drawn from purely theoretical considerations by Mr. Carp, of Java, and Mr. Deerr,* of Demerara, working independently. Here, at any rate, we find practice in perfect harmony with theory.

In order to eliminate calculations as far as possible Table II. is borrowed from Mr. Geerligs' book "Methods of Chemical Control in Cane Sugar Factories." The method of using this Table will be clear from the following examples.

Given juice of 77·0 purity, opposite 77 in the Table we find 88·05 in the first column (headed ·0). If the observed purity be 77·1, the available sugar becomes 88·1, as found in the second column (headed ·1). Similarly, for a purity of 77·9, we look under the last column (headed ·9) and find 88·65. The next tenth in the purity brings us to the second line in the Table, where, opposite 78, we find 88·7 in the first column (which represents 78·0), and so on.

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* The reader is referred to Mr. Deerr's interesting article in the last issue of this Journal.

TABLE II.

SHOWING WHAT PERCENTAGE OF THE INDICATED SUGAR IS AVAILABLE AS CALCULATED FROM THE PURITY OF THE JUICE.

Purity.	·0	·1	·2	·3	·4	·5	·6	·7	·8	·9
77	88·05	88·1	88·2	88·25	88·3	88·4	88·45	88·5	88·6	88·65
78	88·7	88·8	88·85	88·9	89·0	89·05	89·1	89·15	89·25	89·3
79	89·35	89·4	89·5	89·5	89·6	89·7	89·75	89·8	89·85	89·95
80	90·0	90·05	90·1	90·2	90·25	90·3	90·35	90·4	90·5	90·55
81	90·6	90·7	90·75	90·8	90·85	90·9	91·0	91·05	91·1	91·15
82	91·2	91·3	91·3	91·4	91·45	91·5	91·6	91·6	91·7	91·75
83	91·8	91·9	91·9	92·0	92·0	92·1	92·15	92·2	92·3	92·3
84	92·4	92·4	92·5	92·55	92·6	92·7	92·7	92·8	92·8	92·9
85	92·9	93·0	93·05	93·1	93·2	93·2	93·3	93·3	93·4	93·4
86	93·5	93·5	93·6	93·6	93·75	93·75	93·8	93·9	93·9	94·0
87	94·0	94·1	94·1	94·2	94·2	94·3	94·3	94·4	94·4	94·5
88	94·55	94·6	94·65	94·7	94·75	94·8	94·85	94·9	94·95	95·0
89	95·05	95·1	95·15	95·2	95·25	95·3	95·35	95·4	95·45	95·5
90	95·5	95·6	95·65	95·7	95·75	95·8	95·85	95·9	95·95	96·0
91	96·0	96·1	96·1	96·2	96·2	96·3	96·3	96·4	96·4	96·5
92	96·5	96·6	96·6	96·65	96·7	96·75	96·8	96·85	96·9	96·95
93	97·0	97·0	97·1	97·1	97·2	97·2	97·3	97·3	97·35	97·45

The figures thus obtained indicate what percentage of the total *indicated* sugar may be regarded as *available*, and are of considerable interest in judging of the actual manufacturing yields obtained. As these latter cannot easily be ascertained day by day it is sufficient to calculate the available sugar at the end of the manufacturing season, whence the percentages of all sugars on available sugar can be calculated as in Record C below.

THE LABORATORY RECORD.

The analytical and calculated results we have been considering are conveniently recorded as shown on the next page.

RECORD A.

IMPORTS.

	CANES.	JUICE.						
	Tons.	Gallons.	Tons.	Per cent. Juice on Canes	Brix.	Sucrose. Pounds per Gallon.	Purity.	Indicated Sugar Pounds.
June 4..	298·5	40600	194·1	65·0	18·0	1·533	79·5	62240
,, 5....	263·3	36110	172·2	65·4	17·4	1·496	80·5	54021
,, 6..	283·7	38241	182·1	64·2	17·1	1·468	80·5	56138
,, 7....	257·6	34484	164·6	63·9	17·7	1·485	78·5	51209
,, 8..	279·1	37826	180·9	64·8	18·2	1·519	77·9	57458
,, 9....	290·8	39803	189·9	65·3	17·6	1·479	78·6	58869
								339935 =
This Week	1673·0	227064	1083·8	64·8	17·65	1·497	79·3	151·7 tons.
Previously..	8234·7	1110207	5286·7	64·2	17·10	1·458	79·9	722·6 ,,
To Date..	9907·7	1337271	6370·5	64·3	17·18	1·464	79·9	874·3 ,,

The weekly imports of canes, juice, and indicated sugar are added to the amounts carried forward from previous weeks yielding totals *to date*. The latter are then carried forward to the next week's record and so on.

On turning to the columns headed *Percentage of Juice*, *Brix*, *Sucrose*, and *Purity*, it rarely happens that the figures for *this week* can be obtained by merely averaging those recorded for the six days because the quantity of cane and juice treated per day is variable. These figures must, therefore, be calculated from the totals of the three other columns in the manner shown below.

AVERAGES FOR PERCENTAGE OF JUICE ON CANES.

This is a very obvious calculation but we give the figures :—

	Canes. Tons.		Juice. Tons.
This week	1673	yield	1083·8
,, ...	100	,,	64·8
To date	9907·7	,,	6370·5
,, ...	100	,,	64·3

AVERAGES FOR BRIX OF JUICE.

In Table I. (Chapter V.) we find the density of the juice (corresponding to different degrees Brix) expressed in terms of the weight in pounds of one gallon. Hence, by a reverse use of this Table we may arrive at the degrees Brix when the volume and weight of juice are known, thus :—

$$\frac{\text{Weight of juice in pounds}}{\text{Volume of juice in gallons}} = \text{weight in pounds of one gallon,}$$

from which the corresponding degrees Brix may be found in the Table. But, as the weight of juice is more conveniently recorded in tons, the calculation becomes :—

$$\frac{\text{Weight of juice in tons}}{\text{Gallons of juice} \div 2240} = \text{weight in pounds of one gallon.}$$

$$\textit{This week}\ \frac{1083{\cdot}8}{227064 \div 2240} = \frac{1083{\cdot}8}{101{\cdot}4} = 10{\cdot}691 = 17{\cdot}65 \text{ Brix.}$$

$$\textit{To date}\ \frac{6370{\cdot}5}{1337271 \div 2240} = \frac{6370{\cdot}5}{597} = 10{\cdot}671 = 17{\cdot}18 \text{ Brix.}$$

NOTE.—It is preferable to state the degrees Brix to two decimals in order to obtain correct figures for the Purity (see under).

AVERAGES FOR SUCROSE, POUNDS PER GALLON.

The *indicated sugar* being the product obtained on multiplying *gallons of juice* by *pounds sucrose per gallon*, it is obvious that the latter may be calculated from the two former, thus :—

$$\frac{\text{Pounds indicated sugar}}{\text{Gallons of juice}} = \text{pounds sucrose per gallon.}$$

But here, again, we avoid the use of too many figures by recording the indicated sugar in tons, so that the calculation becomes :—

$$\frac{\text{Tons indicated sugar}}{\text{Gallons} \div 2240} = \text{pounds sucrose per gallon.}$$

$$\textit{This week, } \frac{151 \cdot 7}{227064 \div 2240} = \frac{151 \cdot 7}{101 \cdot 4} = 1 \cdot 497.$$

$$\textit{To date, } \frac{874 \cdot 3}{1337271 \div 2240} = \frac{874 \cdot 3}{597} = 1 \cdot 464.$$

It will be seen that the divisor, in each case, is the same as that employed above for finding the *Brix.*

AVERAGES FOR PURITY.

These are calculated from the *Brix* and *sucrose per gallon* as explained in the last chapter.

This week, 17·65 Brix = 10·691 lbs. juice per gallon—

$$\frac{1 \cdot 497 \times 100}{10 \cdot 691} = 14 \cdot 002 \text{ sucrose per cent. by weight}$$

$$\text{and } \frac{14 \cdot 002 \times 100}{17 \cdot 65} = 79 \cdot 3 \text{ purity.}$$

To Date, 17·18 Brix = 10·671 lbs. juice per gallon—

$$\frac{1 \cdot 464 \times 100}{10 \cdot 671} = 13 \cdot 719 \text{ sucrose per cent. by weight}$$

$$\text{and } \frac{13 \cdot 719 \times 100}{17 \cdot 18} = 79 \cdot 9 \text{ purity.}$$

The foregoing calculations appear somewhat formidable, but as the averages are only made out once a week the labour is not excessive.

The record of *Imports* should appear on the left-hand page of a foolscap note book, leaving the opposite page for a record of the *Exports.*

Here, a difficulty arises from the fact that the total weight of exports cannot be known until after several days or even weeks. The general practice in chemical control is to divide the manufacturing season into weekly periods and, at the close of each week, to account for the import of indicated sugar by the produce actually bagged off and the probable yield of produce from the syrup and masse-cuite still on hand. Whilst this course is desirable as a guide to the factory manager, the figures obtained can only be accepted as provisional and subject to correction when the last of the sugar has been bagged off.

Leaving uncertainties aside, what can and should be done in the direction of a weekly balance sheet is to record the percentage of I. Sugar on canes ground, and indicated sugar in the juice, thereby keeping a check on the largest and most valuable of the factory exports. All that is necessary is to arrange that the I. Masse-cuite, left in hand on Saturday night, shall be cured and bagged off separately from the masse-cuite made from the juice received on the following Monday.

RECORD B.

EXPORTS (during current Week).

	I. SUGAR.					II. SUGAR.		MOLASSES.	
	Tons.	Polarization.	Per. Cent. on			Tons.	Polarization.	Tons.	Polarization.
			Canes.	Massecuite.	Indicated Sugar.				
Monday.. ..									
Tuesday ...									
Wednesday ..									
Thursday									
Friday									
Saturday									
Monday.. ..									
This Week ..									
Previously ..									
To Date.. ..									

Record B. is arranged on these lines, and may include a record of the II. Sugar and Molasses exported during the same period but really belonging to an earlier one.

At the close of the manufacturing season the percentages of exports on imports may be summarized as shown in Record C., to which further reference will be made.

RECORD C.

EXPORTS FOR CROP ....

	Raw Sugar.	Containing Pure Sucrose.	Raw Sugar Polarization.	Per cent. of Raw Sugar on				Pure Sucrose recovered per cent. on	
				Canes.	Massecuite.	Indicated Sugar.	Available Sugar.	Indicated Sugar.	Available Sugar.
	Tons.	Tons.							
I. Sugar ..									
II. ,, ...									
III. ,, ..									
All Sugars....									

The weekly records can be condensed into two pages of a foolscap note book; the details of the daily tests being recorded in a separate book, together with all calculations.

In this and the preceding chapter we have endeavoured to make good our former assertion that "the polariscope has the same importance in the sugar factory as has the sextant on board ship."

(To be continued.)

LITMUS AND PHENOLPHTHALEIN AS INDICATORS FOR CANE AND BEET JUICES.

In the March issue of the *International Sugar Journal*, p. 131, it is stated that Mr. Noël Deerr recommends the use of litmus for indicating alkalinity in sugar-house products; this opinion being also held by Mr. Prinsen Geerligs.

It is probable that Mr. Deerr is unacquainted with our own experiments which led us, some 20 years ago, to maintain that phenolphthalein is a very unsatisfactory indicator for all products of the sugar-house, and that it should be replaced by litmus. Not by the solution, which is not very sensitive, but by the neutral litmus paper, prepared as directed by Houzeau. Such paper is not only very sensitive to acid and alkaline solutions, but it is the only indicator which can be employed in testing the alkalinity or acidity of coloured liquids, such as molasses, &c.

This has been repeatedly confirmed, and M. Pellet has dealt very fully with this subject in an essay submitted to La Société Technique et Chimique de Sucrerie de Belgique, in June 1898, and which was awarded the first prize. (This pamphlet can be obtained from the office of *La Sucrerie Belge*, 21, Rue Hydraulique, Brussels, Belgium.)

The same question was also studied by us twelve years ago in connection with cane products, when we came to the conclusion that the only indicator which could be relied upon was the neutral litmus paper recommended by Pellet, who again drew chemists' attention to the unreliable indications of phenolphthalein.

Finally, this question has been discussed at the 6th International Congress of Applied Chemistry, held at Rome in 1906. M. F. Garelli and Mdlle. B. Neppi have fully confirmed M. Pellet's views, and strengthened same by special arguments. Opinions being undivided, M. Pellet requested that the subject should be brought before the general meeting of the Congress, when the following resolution was adopted:—

"In all chemical work connected with the sucrerie alkalinity should be determined with reference to neutral litmus paper prepared as directed by M. Pellet. Fabricants are, of course, free to employ phenolphthalein for routine work if they wish, but practice proves that the use of the latter indicator alone leads to error and that its indications should be controlled by sensitive neutral litmus paper.*"

H. Pellet.

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* Prepared by Gallois, 37, Rue de Dunkerque, Paris.

THE CONTEST BETWEEN BEET AND CANE SUGAR.*

By SIGMUND STEIN, Liverpool.

Sugar is known all over the world, and is cultivated practically everywhere where the sun shines. From the very earliest epochs sugar was known as a food and a very important article of diet.

One often distinguishes between different kinds of sugar, but in fact the product is one and the same. Sugar is sugar, from whatever source or raw material it may be manufactured, but the public distinguish different kinds and varieties, and are led to this belief by announcements, which I am sorry to say are circulated for trade purposes, and which advertise the superiority of one type over the other.

As you know, sugar is manufactured principally from the sugar beet, the cane, and in a very negligible quantity from the sorghum, the maple, and the date palm. A near relation to sugar proper is starch sugar or glucose. This sugar will not be dealt with in my paper, and I only mention it because it is a very strong competitor in the sugar market. This starch sugar is manufactured in very large quantities in the United States of America from maize, on the Continent of Europe from potatoes, and in other countries from various farinaceous raw materials.

1. BEET SUGAR.

Sugar beet is grown nearly everywhere. Nearly every country manufactures its own beet sugar. The home of the sugar beet is, as you know, Germany. For many generations it was thought that this plant could only be grown in certain parts of mid-Europe specially favoured by nature for its cultivation. The German provinces of Saxony and Brunswick, and the kingdom of Bohemia were deemed the only countries where the sugar beet could thrive. But these notions have all changed now, and sugar beet is at present grown commercially in every country of Europe except England. It has become the staple industry of Austria, Germany, France, Belgium, Holland, Russia, and Denmark. In the last few years its cultivation and the manufacture of beet sugar therefrom have been extended as far north as Sweden. Turning to the South European countries like Spain, Italy, Roumania, Servia, Bulgaria, and Greece, we find in all these well-established beet sugar factories. Switzerland, too, has her own sugar factory, and I have myself, by personal investigation on the spot, found that Turkey can grow sugar beet successfully. We also find that the sugar beet cultivation extends as far east as Siberia, Manchuria, and Japan. I have carried on sugar beet experiments in the East Indies and Barbados, and they were most successful. In Persia, also, sugar beets have been grown.

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* Read at the International Congress of Applied Chemistry, Rome, 1906.

Coming to Africa, we find that Egypt is numbered amongst those countries that have cultivated sugar beets. I have myself grown sugar beet successfully in Natal, and a recent communication from the Cape Colony assures me of their willingness to start sugar beet growing in that country.

America has long since gone in for sugar beet growing, thus following the example of old mother Europe. From small beginnings of a few thousand tons of beet sugar in the U.S.A., the production has risen now to 285,000 tons per annum.

Canada, following the wise lead of the United States, is doing everything she can to encourage a home beet sugar industry. Mexico is trying to shortly join the sugar beet growing countries; Chile has successfully grown sugar beet, and the experiments in Argentina have proved that sugar beet can be satisfactorily grown there. I have likewise been informed that some experimenting in sugar beet in Brazil was very favourable. As regards Australia, a sugar factory has been established at Maffra.

You see, therefore, how the sugar beet extends all over the globe. How could it be otherwise when we consider the great advantages which accrue directly and indirectly from its cultivation? In these remarks of mine and others to follow, I wish to ignore as much as possible the present sugar crisis. It is a very difficult thing to talk to a man lying on a sick bed about the beauties of the world, of the many advantages of health and strength, and of the pleasures to be gained from them! The sugar crisis cannot be permanent. The sugar crisis to-day implants the hope of a speedy relief.

Let us for a moment quietly consider and reflect on the history of beet sugar from its birth until it attained maturity, and see how it presents itself to us to-day.

When the father of the world's beet sugar industry, Marggraf, discovered the sugar content in the beet and when the first sugar manufacturer, Achard, made his first loaf of beet sugar, the beet contained only a very small percentage indeed of sugar. But as knowledge increased with man from day to day, so the sugar content of the beet has increased not only from year to year but enormously from generation to generation. Sugar beet at the beginning of last century contained from 5 to 6% of sugar, but when we look at the same plant 100 years later we find it contains about 20% of sugar. If such progress goes on, as our friends, the seed cultivators, prophesy it will do, we shall soon have sugar beetroots producing 50% of sugar!

I mentioned just now the seed cultivators. These are the gentlemen who have brought the beet sugar industry to where it is to-day. Without good seed you cannot produce good beetroots. The seed propagation has brought the beetroot to such a high degree of perfection that it will now withstand the rough climate and all the most distracting influences of bad weather. Did we not see how in

1904 the beetroots stood firm in that year of drought? Did we not observe how they withstood heavy rains?

The sugar beet is not only properly protected against weather but contains a tender core of sweetness enriched by scientific cultivation, and the purity of its character has been so much increased by careful cultivation that now we have begun to wonder if it has not reached its maximum. But science does not stand still. Surely the beetroot will not do so, but will go further and further towards perfection.

The sugar beet proves itself to be a good companion by accommodating itself to every country where it is acclimatized to the habits, climate and people, and if properly treated it shows as good results in new countries as we find it does in its native home. How could it be different? Do I tell you something new when I remind you what an influence the sugar beet has on the agricultural industry and for the country in general? You all know as practical beet sugar manufacturers how beet sugar improves the soil. Its culture requires that the richness of the sub-soil should be brought to the surface by continuous working and clearance of the soil, and the proper and regular manuring brings the soil to the highest grade of perfection such that the next crop in rotation will be a very high one indeed.

We all know the important part the beetroot slices and the molasses play in the feeding of our cattle. We could not find a better manure for our soil than saturation lime. These are facts I have repeatedly mentioned to my British farmer friends.

The extent of beet cultivation in the principal beet countries in comparison with other crops is a very small one. For instance only 1% of the arable land in Germany is sown with sugar beet. Europe can scarcely compete with the United States or Argentina in regard to cereals, but beet culture has proved a very good supplement to cereals. Does it pay the world's beet farmers to grow sugar beet? The answer to this question must be left to the beet farmers themselves because there are different circumstances surrounding the industry in each country. From my own experience I must say that where beet culture has been started and where it has been done rationally, with a proper regard to economy and science, it has always proved successful. In many countries the powerful support of the Treasury has stepped in and protected them by giving some support either to the farmers or to the manufacturers. The principal beet sugar producers in the world are now however deprived of any help or assistance, and so we see to-day the great beet sugar industry of Europe is self-supporting and stands there offering to its rivals a free fight on an open field.

Why should any Government continue to help an industry, if science has aided it far enough and if ingenuity, industry and hard work have brought on the industry to such a degree that it can show a favourable balance sheet? If rosy fingers do not come so often and so permanently to light, we must consider the great advantages which accrue indirectly to the sugar beet producer and to the manufacturer.

Science and art have surrounded the European beet sugar industry in the process of manufacture everywhere. Show me another industry with such an enormous output and where the skill of manufacture is pitched to such a high degree! We have come so far with the help of science that we produce more sugar from the beetroot than the roots originally weighed!

The losses have disappeared! We hear at this Congress discussions on the losses in beet sugar manufacture, but I hope that at the next Congress we shall not need to have any such papers. Beet sugar works are started to-day on a gigantic scale, the small old "kitchens" of former times have disappeared in the struggle for supremacy, and only the fittest have survived. If these extensions continue we shall soon have only a few factories working to cover the whole of the sugar consumption. Sugar science like every other science is international. You cannot hide your discovery, you are bound by natural and moral laws to disclose it, and though we find Europe is the home of the beet sugar industry, yet this old beet country can sometimes learn something from a comparatively new comer. Very often the master can learn something from his apprentice. We have seen that the newer beet countries have designed many improvements which have met with universal adoption.

What I wish to emphasize is the cordial friendship of the European beet cultivators and the beet sugar manufacturers; the hand in hand working of the farm labourers and the farmers, the sugar manufacturers, merchants, and all interested in the industry. I must mention that the beet farmers in Europe have at their call a stock of labourers well versed in the working of the factories, year out and year in, and the same routine passes like tradition from generation to generation. This is a great point, and I want you to consider it carefully for a few moments. It is not enough to have the land to grow sugar beet in a sufficient quantity for the existing beet sugar factory, and to see on your Exchange sugar prices which will show you a remunerative working on your fields or factories! What are all these items if you have not sufficient labour to work your fields or factories? We are very fortunate in Europe in comparison with the great sugar industry in the Colonies which meets with one difficulty after another as regards the labour question. We have occasionally some strikes, but they are only sporadic. They generally rise just to pass the time away, and are usually finished overnight! You will hear later on what great trouble our friends in the cane sugar industry have to put up with. Let me mention that here our rains do not last for months, but scarcely days, they seldom interrupt us in the tillage of the sugar beet; earthquakes and storms do not occur more than once a week in our beet lands! If the beet people spend pfennings and cents on their beet fields, just see how many gold and silver coins are spent by our cane friends on their cultivation.

I might say beet culture in Europe goes like a good old grandfather's clock, it runs smoothly and nicely and never stops. It goes on its way interrupted only by scientific progress. Compare it with the new mechanism adopted in the cane countries! In these cane countries the machinery goes and goes until it is suddenly interrupted by a superior power, the sublime power of nature, the action of the Government or the discontent of the population, which destroys all hope of the ingenious hard-working manufacturer, and the unfortunate capitalist and investor.

The beet manufacturers in Europe are very fortunate to have the co-operation of the farmers, for many factories in Germany and Austria are owned by the latter exclusively. The farmers being the suppliers of raw material, show their faith in the venture by keeping their shares in the factories. Such a co-operation makes an industry strong! Unity is strength. Could there be a firmer, more solid, more reliable basis for an industrial undertaking than co-operation?

The question may be asked whether the beet culture can be extended further in the same ratio as it has been done during the few last decades. It all depends. Sugar is cultivated to be eaten, and you cannot transfer the production and the consumption of beet sugar from one generation to another. If our consumption increases, as all of us here hope it will, there is no reason why every beet country in the world should not increase her production at least 100%. The Continental countries of Europe have not yet reached the high figures of consumption prevailing in England and the U.S.A. We are now just in the critical stage which medical men generally describe as *crisis*; but if you keep calm this crisis will not prove fatal yet. The strong and healthy disposition of the Continental beet sugar industry will overcome it, and it will soon regain fresh life. It seems rather strange just now to speak to you about increasing the beet area and the possibility of its increasing, when you hear everybody on the Continent talking, preaching, and writing about decreasing the area which should be sown with beet in 1906. Of course, for the present such a thing would be a healthy measure. The sugar area should be decreased. Cane and beet should combine and arrange that this decrease should be mutual.

For the increase in the consumption of sugar cannot take place at once, and the present large stocks hanging over the market must be cleared away as soon as possible.

(To be continued.)

THE CHEMICAL SELECTION OF SUGAR CANE.*

By J. D. Kobus (Java).

During the second half of the 19th century frequent experiments were carried out in order to improve the varying properties of cultural plants by means of selection and often with good results. Mention need only be made of the experiments of Vilmorin and others to increase the sugar content of the beet and the extraordinary good results which accrued therefrom.

This considerable progress in the sugar contents of beets by suitable selection was the direct incentive to my commencing the attempt to evolve a method of selection suitable for the sugar cane.

As we did not then know whether asexually propagated cane (wherein all specimens of a variety were really only parts of a single individual system) would show such strong divergences in sugar content as to make a selection feasible, this problem was the first step in our investigations. If real differences in sugar content were revealed which descended through the cuttings to the subsequent asexual generation, one could be pretty sure that just by means of this asexual propagation progress in sugar content would continue a longer time than in the case of plants which were produced from seed.

Since 1897 I have carried out very extensive researches, during which from 50,000 to 100,000 single plants, as well as 150,000 to 200,000 plants in small parcels of 40 to 100 specimens, were all analysed. The results obtained were in due course fully dealt with in the pages of the Java *Archief*. I shall therefore confine myself here to a short survey of the experiments undertaken and the results accruing therefrom.

In the first place it was necessary to determine *how* the selection should be carried out, *i.e.*, whether we should start on *sugar cane plants* or on cane stalks. We thereupon tested over 2,500 single stalks from 360 plants belonging to five different varieties. The specific weight (Brix) and the polarization of the expressed cane juice was obtained and after the formula $2S - B$ the the sugar content of each individual stalk was recorded.

The results showed that the sugar content of different well developed and equal aged shoots of the same cane can sometimes show great differences as in the case of Plant 49 (below); at other times be pretty much alike, as in Plant 87.

	Plant 49. Sugar content. Per cent.	Plant 87. Sugar content. Per cent.
Mother stalk	9·2	12·8
Principal side shoot	13·5	12·7
,, ,,	12·1	12·3
,, ,,	6·9	12·5

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* Read at the Int. Congress of Applied Chemistry, Rome, 1906. Special translation for *I.S.J.*

In general we found, however, that all or nearly all the shoots of a plant varied in this respect and we could mention for example a variety of Fiji Island cane, the shoots of which contained less than 10%, between 10% and 14%, and over 14% of sugar content, respectively, where even individual stalks themselves showed not seldom strong differences.

The sugar content lies between very wide limits in the different cane varieties. While the percentage in the above-mentioned variety, which was sent us from Fiji, varied from 3% to 17% in available sugar, the limits in the case of some seedling canes reared by us were 10% and 20%.

Though we had found that large variations existed in the sugar content of healthy and equally aged stalks of the same sugar cane plant (variations amounting to 8 % of sugar), I did not deem it wise to employ the stalks richest in sugar as a starting point for chemical selection, since it might be possible that large differences in the sugar content of the shoots from the same mother plant would eventually develop in their descendants.

We therefore selected the richest *plants*, and had in consequence the advantage of being able to weed out almost all plants which possessed shoots having large differences in sugar content, both in the rich and in the poor groups.

In order to eliminate certain nominal differences of climate and soil which could arise from year to year, descendants of rich and of poor parent plants were always compared with one another. Thus from the Fiji canes we planted near one another cuttings from plants with more than 14 % and with less than 10 % of sugar content. In the following year the descendants showed the following results:—

Content of available Sugar. Per cent.	Progeny of Plants rich in Sugar.	In Per cent.	Progeny of Plants poor in Sugar.	In Per cent.
3-4	..	..	1	0·3
4-5	..	..	..	..
5-6	..	..	2	0·6
6-7	..	..	4	1·2
7-8	1	0·3	8	2·5
8-9	8	2·7	19	5·8
9-10	13	4·4	34	10·4
10-11	27	9·2	52	16·0
11-12	40	13·6	63	19·3
12-13	46	15·6	63	19·3
13-14	70	23·8	51	15·6
14-15	49	16·7	12	3·7
15-16	32	10·9	17	5·2
16-17	8	2·7	1	0·3

There is thus an appreciable difference. In the first group we found more plants rich in sugar, in the second more plants poor in sugar. The average content of the first group was 13·2%, of the second 11·7%.

Similar results, though not so striking, were obtained from the remaining lots, and as the success of the chemical selection seemed now apparent, we again selected a row of cane varieties in the same manner, and commenced our research on a big scale. From the already selected groups cuttings from the richest plants of the richest groups were planted out next to the cuttings from the poorest plants of the poorest groups, whereby some 6,000 plants of seven different varieties were individually tested, and the specimens respectively richest and poorest in sugar were planted out.

Simultaneously with this analysis, the weights of the individual plants were recorded and gave very astonishing results; these can best be seen by an inspection of the table below :—

	Poor Plants.		Rich Plants.		
Cane Varieties.	Sugar content less than Per cent.	Average weight of stalk. Kilog.	Sugar content less than Per cent.	Average weight of stalk. Kilog.	Per-centage difference in weight.
Fiji	7·0	2·45	14·0	3·75	53
White Manilla	7·0	2·10	13·0	3·60	71
Black ,,	10·0	2·16	16·5	3·88	80
Seedling No. 100	14·5	4·57	18·5	6·68	46
Cheribon No. 1	13·5	2·62	19·5	3·84	47
,, No. 2	16·0	1·73	21·0	2·92	71
,, No. 3	17·0	2·05	21·0	3·12	52
,, No. 4	17·0	2·22	21·5	3·06	38

We therefore see that with all varieties the plants rich in sugar are heavier than those poor in sugar.

This unexpected correlation of two such favourable characteristics induced me to find out whether, conversely, the heaviest plants were also the richest. All experimental plants were therefore grouped according to their weights as "0 to 1 kg.," "1 to 2 kg.," and so on, and the average sugar content of each group was calculated. These averages of the different varieties were as under :—

Available Sugar in Sugar Cane Juice.

Weight. Kilog.	Fiji Cane. Per cent.	Black Manilla. Per cent.	White Manilla. Per cent.	Seedling No. 100. Per cent.	Cheribon. Per cent.
0 to 1	8·4	12·4	7·3	16·0	18·3
1 ,, 2	10·0	13·2	9·3	16·3	18·4
2 ,, 3	10·4	13·8	9·8	16·8	18·8
3 ,, 4	10·8	13·7	10·4	16·3	19·4
4 ,, 5	11·3	14·7	10·9	16·7	19·5
5 ,, 6	11·2	15·0	11·3	17·0	19·6
6 ,, 7	11·7	16·6	11·2	17·2	..
7 ,, 8	..	16·5	..	17·1	..
8 ,, 9	..	18·2	..	17·3	..

The heaviest plants are therefore the richest in sugar.

It remained to discover whether, besides richness in sugar, an increased weight was a an inherent property of sugar cane. For that purpose 7000 of the progeny of selected plants were individually weighed the following year and their juice analysed. In general our expectations were realized, and it was found in practice that the progeny of the rich plants were generally heavier and richer than those of the poor plants. There were, it is true, a couple of exceptions, but these can be accounted for in part as experimental errors.

As in 1898, we found again that in the case of all thick stemmed varieties, weight and sugar content increased together, so that this important characteristic is demonstrated by the individual analyses of more than 2000 plants. Besides that, we obtained the same results by a large scale experiment with about 40,000 kg. of cane stalks which were taken from either light or heavy plants.

Since it had been shown that differences of soil can exercise a very large influence on the composition of sugar canes, we next proceeded to prepare several small experimental plots, and these were planted alternately with cuttings from poor and from rich canes.

The resulting crop gave average results. We found :—

YIELD PER HECTARE.

	PROGENY OF POOR PLANTS.			PROGENY OF RICH PLANTS.			
	Weight of Cane. Kilog.	Sugar in Juice. Per cent.	Available Sugar. Kilog.	Weight of Cane. Kilog.	Sugar in Juice. Per cent.	Available Sugar. Kg.	Increase in Sugar. Per cent.
White Manilla	53,065	12·68	5,647	62,598	13·50	6,750	19·7
Black ,,	50,470	15·70	6,333	60,883	16·62	8,097	27·9
Puri	70,683	10·54	5,954	72,275	14·74	8,514	43·1
Seedling No. 100.	67,375	17·54	9,433	71,663	17·79	10,192	8·1
Chunnee	68,845	10·49	4,337	64,435	13·61	5,268	21·5
Cheribon	49,735	13·35	5,316	53,333	15·13	7,156	44·0

Here, by means of six varieties of sugar cane possessing very different crop yields and sugar contents, conclusive evidence was tendered that *the progeny of rich plants are heavier and richer in sugar and that therefore a selection based on the sugar content is quite rational.*

When I had established this point, a further question forced itself to the front, whether it was nominally possible by progressive selection made year by year (in which the progeny of the richest plants from the richest groups were always compared with the poorest plants of the poorest groups and with those of plants of middling composition) to obtain a permanent increase in sugar content.

For this experiment, which has now been in progress for five years, we took about 30,000 kg. of plants of a cane variety (Djamprok) considered immune from several diseases and analysed them singly; and every year a large number of experimental plots were laid out in several parallel rows.

By means of this variety we were able to obtain results from 33 experiments with several hundred plots; and these are summarized in the table below, where to simplify calculations, the crop figures for the canes of middling composition are given as equal to 10, 100, or 1000 respectively.

FIVE YEAR SELECTION OF DJAMPROK CANE.

	Experiments.	CANE CROP.			SUGAR.			PER CENT. SUGAR IN CANE.		
		Rich.	Med.	Poor.	Rich.	Med.	Poor.	Rich.	Med.	Poor.
After 1 Selection	10	1024	1000	983	105·4	100	94·6	10·39	10	9·55
,, 2 Selections	10	1035	1000	922	107·6	100	83·9	10·43	10	9·15
,, 3 ,,	7	1032	1000	936	111·8	100	81·1	10·83	10	8·67
,, 4 ,,	5	1050	1000	946	122·8	100	78·9	11·69	10	8·26
,, 5 ,,	1	1123	1000	784	139·4	100	38·8	12·42	10	4·94

At the same time these experimental plots would serve to supply material for other experiments whereby it was sought to prove (what already seemed to be *a priori* the case through the asexual propagation of canes) that nominally the hardly-secured characteristic of an increased sugar content would, without further selection, remain, to a fairly large extent, in the subsequent generation.

Of the above-mentioned 33 experiments with Djamprok cane, a portion of the material was nearly always replanted without further selection, and every experiment begun in this direction was proceeded with every year till 1905 without undergoing any further selection.

As a result, 40 further experiments were undertaken—28 with once-selected and 12 with twice-selected cane. But from the frequently selected canes, too few experimental plots of unselected were re-planted as to provide good averages. In all these experiments, care was always taken not to plant the rich, middling and poor plants, respectively, in either too small or too large plots, so as to eliminate as much as possible individual and soil differences. Each experiment consisted of at least 18 plots. They yielded:—

	Experiments.	Cane Crop.			Sugar.			Per Cent. Sugar in Cane.		
		Rich.	Medium.	Poor.	Rich.	Medium.	Poor.	Rich.	Medium.	Poor.
		After a single selection replanted unselected during								
One Year	8	1023	1000	1010	105·2	100	99·7	10·27	10	9·84
Two Years	8	1019	1000	980	102·5	100	94·8	10·06	10	9·67
Three ,,	8	1014	1000	996	106·9	100	101·1	10·54	10	10·15
Four ,,	4	1006	1000	1001	106·2	100	97·2	10·56	10	9·70
Mean	28	1017	1000	996	105·1	100	98·3	10·33	10	9·86
		After two-fold selection replanted unselected during								
One Year	4	1089	1000	985	109·0	100	94·4	10·05	10	9·59
Two Years	4	998	1000	985	103·2	100	95·2	10·34	10	9·65
Three ,,	4	1031	1000	951	108·3	100	88·9	10·50	10	9·35
Mean	12	1039	1000	974	106·8	100	92·8	10·30	10	9·53

We, therefore, perceive that the augmented sugar production occasioned by *selection* remained almost fully as high (92%) in the following years, and this as a mean result of 40 different experiments with over 1000 plots and some tens of thousands of plants.

The smaller sugar production of the poor groups is equally constant if apparently not to the same extent (39%) as the larger production of the rich groups.

(*To be continued.*)

THE HAWAIIAN SUGAR PLANTERS' ASSOCIATION REPORT AND YEARBOOK.

This well printed and finely illustrated publication, of about 700 pages, gives an account of the work done, and of the bulletins issued (during the year ending October, 1905) by the Hawaiian Sugar Planters' Association.

The Hawaiian Sugar Planters' Association Experiment Station is divided into three divisions: that of agriculture and chemistry, that of entomology, and that of pathology and physiology. Attached to each division there is a highly efficient staff, and the photographs of the laboratories which appear in the report show that they are equipped in a manner usually only to be found in a University or institution of similar standing.

Mr. C. F. Eckart is director of the division of agriculture and chemistry; that of entomology is presided over by Mr. R. C. L. Perkins, Dr. N. A. Cobb, well known in connection with his researches on cane diseases in Queensland, being in charge of the division of pathology; associated with Dr. Cobb is Mr. Lewton-Brain, who a year ago was engaged in similar work with the Imperial Department of Agriculture in the West Indies.

Some salient points of interest are worth abstracting from this report.

The work of the division of agriculture and chemistry comprised general analytical work to the extent of 1478 analyses, of which those of fertilizers and soils formed a large proportion: in this connection it is interesting to note that a calculated rebate of $5636 was saved to purchasers of fertilizers, which on analysis were found to be below the makers' guarantee. In 1900 the rebate claimed on a much smaller number of analyses was $12,000, showing that, under a strict system of inspection, very considerable sums may be saved to the purchasers of manures.

The bulletins issued by this division contain reports on analyses of varieties of canes, on fertilizer experiments, and on irrigation tests.

The analyses of the varieties of canes are among the most (if not actually the most) complete that have ever appeared. They include not only the weight of cane per acre, but also the weight of tops and of trash, the amount of lime, potash, &c., removed from the soil by the different varieties, and the results are tabulated so as to show the amount of plant food required to form 1 lb. of sugar with respect to the different varieties.

In connection with this series Mr. Eckart writes:—

"It is indicated quite clearly in the foregoing tables that the different varieties, when grown under like conditions, make different demands on the plant food of the soil. For instance, Striped Singapore appropriated 7·7 lbs. of nitrogen for each ton of solid matter produced, while Demerara 117 only contained 4·2 lbs. of this element per ton of solid matter. With respect to phosphoric acid, the largest amount was found in Demerara 74, in which case 8·4 lbs. of this material were extracted from the soil: with Queensland No. 1 only 3·7 lbs. were taken into the plant per ton of solid matter. Using the same basis, *i.e.*, one ton of solid matter, we find that Demerara No. 74 contained the largest amount of potash or 35·1 lbs. With respect to lime the largest amount, 7 lbs., was found in La. Striped; the smallest amount, 3·9 lbs., in Demerara No. 74."

If the matter ended there, information of the highest value to the planter would be easily obtained, but after comparing the results of two crops Mr. Eckart writes:—

"These results show conclusively that the analysis of a variety of cane grown in one locality offers no indication as to what its composition will be in another, and also that varieties will vary as to the relative amounts of the principal plant foods which they contain, when grown in the same localities, but during different seasons. The wide variation displayed by the different varieties as regards their content of lime, phosphoric acid, potash and nitrogen, for two different crops points strongly to the fact that no definite conclusions can be reached as to their relative economy in the utilization of the soil elements unless possibly the varieties are subjected to comparative analyses for many successive crops and an average taken for the separate canes. It is very probable, however, that if under such circumstances, we were able to gauge their relative plant food requirements for one locality, that for other localities the order would need to be modified."

Bulletin XIV. deals with irrigation experiments on the Lahaina and the Rose Bamboo varieties. (Mr. Eckart states elsewhere that the Lahaina is the Bourbon and the present writer believes that the Rose Bamboo is the White Transparent.) With the Lahaina the best results were obtained with a weekly irrigation equal to three inches of water, but the Rose Bamboo responded best to an irrigation of two inches. The bulletin is supplied with very complete tables shewing the duty of the irrigation water and Mr. Eckart very pertinently concludes the bulletin with the remark: "The large gain in sugar resulting from the weekly three inch irrigation of the Lahaina ratoon cane emphasizes in a particular degree the fact that conclusions cannot be drawn with safety from a one crop test. The plant crop only showed a gain of 2,333 lbs. of sugar on increasing the irrigation from one inch to two inches per week, while the average gain for two crops amounted to 7,862 lbs."

Bulletin XV. contains a summary which should be read in detail of the fertilizer experiments initiated by Dr. Maxwell, in 1897. Mr. Eckart's conclusions are—

"(1) Lands capable of producing eleven tons of sugar to the acre without fertilization may be fertilized with profit, climatic conditions and water supply being favourable.

"(2) While soils of high fertility may respond to mixed fertilizers the percentage of gain is greater, as the soils suffer a gradual exhaustion.

"(3) The Rose Bamboo and Lahaina varieties of cane did not show the same response to various combinations of fertilizer ingredients.

"(4) It is indicated that Rose Bamboo requires a larger store of phosphoric acid to draw from than Lahaina for the best results.

"(5) Lahaina cane responded more to an increased supply of potash in the soil than Rose Bamboo.

"(6) Both Rose Bamboo and Lahaina cane showed a considerable gain in yields from fertilization with nitrogen. The percentage of this element in the soil, on which the tests were carried out, was below the average for the islands.

"(7) On a soil containing phosphoric acid (soluble in a one per cent. solution of aspartic acid), in quantities which were in large excess of those contained in the average soil, phosphoric acid applied with nitrogen gave yields of Rose Bamboo cane exceeding those obtained when nitrogen was applied alone. Under the same conditions Lahaina cane gave about the same yields following fertilization with nitrogen as when nitrogen was applied with phosphoric acid.

"(8) On a soil containing potash (soluble in a one per cent. solution of aspartic acid) in quantities comparing closely with those of the average island soil, Rose Bamboo and Lahaina cane gave increased yields when this element was applied with nitrogen.

"(9) The separate application of phosphoric acid in soluble forms to lands standing high in phosphoric acid may result in a loss of sugar rather than in a gain. It is indicated that the chances of loss are greater with Lahaina cane than with the Rose Bamboo variety in localities where the two varieties make an equally thrifty growth under normal conditions.

"(10) Separate applications of potash in the form of sulphate of potash may decrease the yield of cane. The danger of loss is apparently greater with the Lahaina cane than with the Rose Bamboo. This refers to applications of sulphate of potash to lands under cane.

"(11) The fact that the application of one particular element gives negative results with respect to fertilization, does not warrant the assumption that the element in question may, with profit, be omitted as a component part of mixed fertilizers. Applied with another element the gains may be considerably greater than could be obtained with the latter element alone.

"(12) With both varieties the purest and richest juice was obtained from the cane on the unfertilized area. In general, the plats receiving incomplete fertilizers yielded juices of greater purity than those plats to which the three elements were applied together."

Two series of new experiments will be harvested in 1906. One of these is an irrigation experiment, where the humidity and temperature of the atmosphere is taken into account in determining the amount of irrigation water, and the second deals with the benefit or otherwise of fallowing and ploughing in a crop of Mauritius beans. The results of these experiments should be anticipated with great interest.

The report of the division of entomology contains a monograph of the enemies of the leaf hopper, which has recently done so much damage in Hawaii. The report is highly technical, so much so that it is unsuited for abstraction.

Elsewhere is given an account of the mission of Mr. Perkins and Mr. Koebele to Australia in search of parasites of the leaf hopper: this account shows clearly the difficulties they encountered, and how they were overcome, and forms a most interesting chapter in economic entomology.

The division of pathology and physiology has issued three reports. That on the root disease of the sugar cane is by Mr. Lewton-Brain, and being of a preliminary nature adds but little to what has already been published on this subject in the West Indies. Mr. Lewton-Brain remarks however that he is yet uncertain that the Hawaiian and the West Indian diseases are identical.

Dr. Cobb continues his account of the gumming disease and brings together in one paper his own and the researches of Dr. Erwin Smith and of Mr. Greig Smith.

A most interesting and important article is given by Dr. Cobb on the inspection and disinfection of cane cuttings. Dr. Cobb emphasizes as strongly as he can the necessity of only using as seed cuttings that show no sign of fungus attacks. He seems to be of the opinion that fungus attacks on the cane are to a very large extent dependent on the use of infected seed. The question of disinfection of seed with Bordeaux mixture is thoroughly gone into, and experiments are quoted to show its efficacy. Similar experiments leading to the same conclusion have been already made in the West Indies. The bulletin is illustrated with a coloured plate showing the appearance of cane which it is not desirable to use as seed: this appearance will be all too familiar to planters in every part of the world. Several plates illustrate methods of applying Bordeaux mixture to seed cane on the estate scale.

Turning to manufacture, a point of great interest may be noted in the report of the committee on manufacture, and that is the complete success of quadruple crushing. This plant with a dilution only 16·41 % on normal juice recovered 95·34 % of the sugar in the cane. Some three-mill sets approached and even exceeded this extraction but only at the expense of a very much higher dilution. The extraction by the four-mill set in respect to quantity of water used is in every way comparable with that now being obtained with the Naudet process.

It is further of interest to note that as many as 38 factories have united in a scheme of mutual control and interchange of factory results. Such a scheme has been in vogue for many years past in Java.

Amongst so much that is excellent it is hard to find fault, but the adoption of a one per cent. solution of aspartic acid as a soil solvent is perhaps to be deprecated; the present writer is aware that this solvent was originated by Dr. Maxwell, with special reference to cane culture in Hawaii; but the method is only a variant of Dr. Dyer's scheme of using a one per cent. solution of citric acid, and the latter has by this time been generally accepted as a standard process.

In dealing with the subject of the introduction of new varieties of canes, Queensland B 147, and Queensland B 208 are mentioned; these are, the present writer takes it, the Barbados seedlings, B 147, B 208, which have found their way to Hawaii *via* Queensland, and have thus in Hawaii received as their distinguishing name the country from which they were received and not the country of their origin. Will not this process tend to still further confound the nomenclature of the cane?

N. D.

THE COMPOSITION OF THE SUGAR CANE AND ITS PRODUCTS IN LOUISIANA.*

By Dr. CHARLES A. BROWNE, Jun., New Orleans.

The object of this paper is to present as briefly as possible a few facts and figures relating to the composition of the sugar cane and its products in Louisiana. The data collected here represent a summary of work performed during the past few years in the sugar house and laboratories of the Sugar Experiment Station of the Louisiana State University, at Audubon Park, New Orleans.

As is well known, the sugar cane in Louisiana, on account of the cool winters, seldom reaches maturity. It is only during an exceptionally mild winter, such as the one just past, that the cane arrows and produces seed and this occurrence then is confined entirely to the extreme southern parishes of the State along the Gulf. The conditions of growth, and the method of cultivating the cane crop in Louisiana are therefore necessarily very different from tropical countries, and as a result very marked differences are evident in the composition of the cane and its products between the two regions. It should also be remarked that within Louisiana itself a great dissimilarity of conditions prevails, not only as regards climate but also in the character of soils and processes of manufacture, so that there are perhaps wider local variations in composition than are noticeable in any other cane producing country.

Table No. I. shows the proximate analysis of the leaves, stalks, roots and seed of the sugar cane, according to analyses by Halligan and Agee:

TABLE I.

Proximate Analysis of Sugar Cane.

		Leaves. Per cent.	Stalks. Per cent.	Roots. Per cent.	Seeds. Per cent.
Water		74·38	74·96	68·79	11·03
Ash		2·23	0·64	1·87	5·22
Fat and Wax		0·69	0·38	0·54	2·01
Crude Protein		1·70	0·58	1·59	8·47
Fibre	Crude Cellulose	9·18	4·86	9·58	25·51
	Pentanosans	5·49	3·04	7·04	26·26
	Lignin bodies	4·13	2·14	4·25	21·50
Sugars, &c.		2·20	13·40	6·34	....
Total		100·00	100·00	100·00	100·00

A somewhat closer inspection of the various constituents given in Table I. will be of value, particularly as regards the composition of the cane stalk.

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* Read at the International Congress for Applied Chemistry, Rome, 1906.

Water.—The water content of the sugar cane is somewhat variable, decreasing as the period of maturity advances and also depending upon the wetness or dryness of the season. Canes after being cut lose water rapidly from evaporation, with a corresponding increase in the solids of the juice. Analysis of juices from such canes may lead to erroneous conclusions regarding sugar content.

Ash.—The percentage composition of the ash of the sugar cane in Louisiana is found to vary widely according to the variety of the cane, type of soil, and manner of fertilization. Analysis made by Hall of the ash from the leaves, stalks and roots of the Demerara No. 74 cane are given in Table II.

TABLE II.

Composition of Ash of Sugar Cane.

	Ash of Leaves. Per cent.	Ash of Stalk. Per cent.	Ash of Roots. Per cent.
Potash, K_2O	31·25	38·23	17·39
Soda, Na_2O	1·17	1·30	0·85
Lime, CaO	5·90	5·19	3·45
Magnesia, MgO	5·11	5·76	2·61
Iron Oxide, Fe_2O_3	1·45	1·13	3·60
Alumina, Al_2O_3	1·03	0·25	4·70
Silica, SiO_2	30·32	15·70	49·52
Phosphoric Acid, P_2O_3	7·25	5·27	3·99
Sulphuric Acid, SO_3	11·29	18·47	9·15
Carbonic Acid, CO_2	1·10	2·70	0·45
Chlorine, Cl	3·08	4·52	0·98
Carbon	3·95	4·05	2·30
Total	102·88	102·57	98·99
Deduct O = Cl	1·39	2·04	0·44
	101·49	100·53	98·55

Fat and Wax.—The fat or oil of the cane is very small in amount and is confined mostly to the interior tissues. The wax, on the other hand, is found entirely upon the outer surface of the stalk and constitutes about one per cent. of the rind. Cane wax was first studied by Avequin of New Orleans in 1840, and the name *cerosin* was given by him to the substance. The body melts at 82°, and analyses by Levy in the laboratory of Dumas showed it to have the probable formula $C_{12}H_{48}O$.

Nitrogenous bodies.—The total amount of nitrogen in the stalk of the sugar cane is only about 0·05 per cent. This small amount, however is distributed among a large number of different bodies, such as albumen, nucleoproteids, peptones, amido-acids, ammonia, and nitrates. The percentage of these different ingredients are subject to considerable fluctuations according to the age of the cane and the manner of cultivation and fertilization.

Fibre.—The percentage of marc or fibre in the stalk of the sugar cane in Louisiana at the time of maximum maturity is about 10 per cent. The fibre is distributed among the three tissues, the rind, the pith, and the fibro-vascular bundles. The percentages of these tissues in the cane-stalk and in the dry fibre are as follows:—

	Pith. Per cent.	Bundles. Per cent.	Rind. Per cent.
Whole cane (3 analyses)	2·39	1·81	5·51
Dry Fibre	24·66	18·60	56·74

A proximate analysis of the above tissues is given below. The results were calculated to a moisture-free basis.

TABLE III.

	Pith. Per cent.	Bundles. Per cent.	Rind. Per cent.
Ash	1·68	3·58	1·64
Fat and Wax	0·41	0·72	0·98
Protein	1·94	2·00	2·19
Cellulose (method of Cross and Bevan)	49·00	50·00	51·09
Pentosans (furfuroids)	32·04	28·67	26·93
Lignin (by difference)	14·93	15·03	17·17

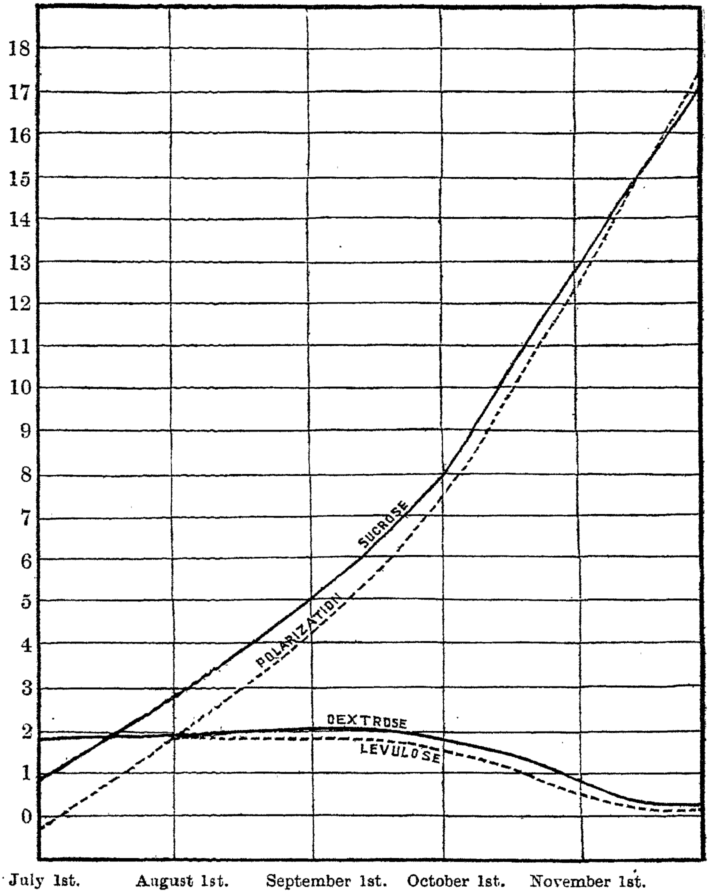
A study of the hydrolytic products obtained by digesting cane fibre with caustic soda shows cane fibre to be an exceedingly complex substance. The approximate percentages of the different hydrolytic products are given in Table IV.

TABLE IV.

	Per cent.
Cellulose (including oxycellulose)	55
Xylan	20
Araban	4
Lignin	15
Acetic Acid	6

Sugars.—Sucrose, dextrose, and levulose are the only sugars which occur normally in the stalks of the sugar cane. The pentose sugars, xylose and arabinose, seem to occur in traces in decomposed canes, the result no doubt of the inversion of the xylan and araban contained in the fibre. The presence of maltose and raffinose has been reported in the sugar cane, but this requires confirmation.

The relation of the three sugars, sucrose, dextrose and levulose, to one another during the period of growth of the cane undergoes marked changes; this relationship and its effect upon the polarization of the juice is best shown by means of a diagram.



It will be noted that at very early stages of growth the dextrose and levulose are present in equal amounts, and that the juice shows a minus reading owing to the preponderance of invert sugar. Somewhat later the juice becomes optically inactive, though double polarization shows about one per cent. of sucrose. Then the rotation becomes a positive quantity and, as the cane matures, gradually approaches the true percentage of sucrose, until finally the polariscope reading and true percentage of sucrose coincide. At this stage the polarization of the levulose, which has decreased more rapidly than the dextrose, exactly neutralizes the rotation of the latter sugar. If conditions are favourable for complete ripening, the levulose will nearly or completely disappear; the rotatory power of the dextrose will then cause the polariscope reading to slightly exceed the true percentage of sucrose. The latter condition, however, rarely prevails in Louisiana, and when it does occur is usually the result of the stoppage of growth by a long spell of cold weather.

Among the other ingredients of the cane which are not given in Table I. should be mentioned the Pectin or Gums and the Acids.

Pectin or Gums.—These are the hemicellulosic bodies which escape into the juice when the cane is milled. These gums are precipitated from solution by alcohol, and analysis shows them to consist of xylan, araban, and traces of galactan, the latter being more evident in unripe canes.

Acids.—The organic acids of the sugar cane exist partly in the free condition and partly combined with potash and other bases. Aspartic, malic, and succinic acids are among the more important of these acids. Glycolic acid has been reported in green canes. Tannic acid is present in small amounts in the peripheral parts and in the eyes and bud.

EXPRESSION AND COMPOSITION OF CANE JUICE.

The juice is removed from the cane in Louisiana almost entirely by means of mills, of which there are the greatest variety of types and patterns. The most general method practised in the large central sugar houses consists in a preliminary crushing between heavy corrugated rollers. The crushed cane in the form of a blanket then passes through a three-roller mill, and after maceration with a sprinkling of water, through a second mill of the same description. In this way an extraction of from 75 to 80 per cent. of the weight of cane is obtained. The residual bagasse, which contains from 45 to 50 per cent. of water, is then burned beneath the boilers, where it constitutes about 60 per cent. of the total fuel.

The process of diffusion is used at present in only three of the 260 sugar houses in Louisiana. The increased expense of evaporation, the loss of the bagasse as a fuel, and the trouble in disposing of the exhausted chips, have been the chief obstacles against the extensive use of the diffusion battery. The utilization of bagasse for paper making, which is being agitated at present, may increase its value over that for fuel (about $2·00 per dry ton as compared with coal), and in that event we may witness a greater extension of the diffusion process, the successful application of which to the cane industry was thoroughly demonstrated in Louisiana years ago by Dr. H. W. Wiley.

The composition of the average undiluted juice as it is obtained from the mill in Louisiana is given in Table V.

TABLE V.

Composition of Sugar Cane Juice.

	Per cent.	
Water	85·00	
Ash	0·40	
Nitrogenous bodies	0·26	
Sucrose	12·00	
Dextrose	1·00	
Levulose	0·70	
Free Acids	0·10	
Combined Acids	0·15	
Pectin	0·10	
Fat and Wax	0·10	Mechanical impurities removed from the cane during milling.
Fibre particles	0·12	
Dirt	0·06	
Tannin, colouring matter, &c.	0·01	
	100·00	

The composition of the ash from the juice of different varieties of cane according to analyses by Hall is given in Table VI.

TABLE VI.

Composition of Ash from Sugar Cane Juice.

	HOME CANES.		SEEDLING CANES.	
	Purple. Per cent.	Ribbon. Per cent.	Demerara 74. Per cent.	Demerara 95. Per cent.
Potash, K_2O	49·63	47·65	44·21	40·66
Soda, Na_2O	1·81	1·13	1·11	0·63
Lime, CaO	3·00	3·79	4·62	4·33
Magnesia, MgO	3·21	3·73	7·45	5·70
Iron Oxide, Fe_2O_3	0·70	0·45	1·15	1·48
Alumina, Al_2O_3	0·40	0·32	0·18	1·25
Silica, SiO_2	4·80	5·92	6·20	9·30
Phosphoric Acid, P_2O_5	5·80	6·38	5·31	5·39
Sulphuric Acid, SO_3	20·40	20·59	22·46	23·69
Carbonic Acid, CO_2	4·10	3·30	3·40	3·40
Chlorine, Cl	5·80	5·83	5·36	3·26
Total	99·65	99·09	101·45	99·09
Deduct $O = Cl$	2·62	2·64	2·42	1·47
	97·03	96·45	99·03	97·62
Carbon and undetermined	2·97	3·55	0·97	2·38
Alkalinity (cc. $\frac{n}{10}$ per grm. Ash)	36 cc.	30 cc.	24 cc.	22 cc.

The canes were taken from the same plot and were grown under perfectly similar conditions of cultivation and fertilization. While all the analyses show a certain uniformity, the difference in composition between the ash of the home canes and the seedlings is well marked.

The distribution of the nitrogen among the different ingredients of cane juice is shown from the following analyses by Hardin in Table VII.

TABLE VII.

Distribution of Nitrogen in Cane Juice.

	Percentage in Juice.	Percentage of total Nitrogen.
Nitrogen in Albumen	0·0039	9·47
,, in Nuclein bodies	0·0025	6·32
,, in Albumoses	0·0021	5·26
,, in Amido acids	0·0122	30·53
,, in Amido acid amids	0·0098	24·47
,, in Ammonia	0·0024	6·18
,, in Nitrates	0·0071	17·77
,, in Nitrogenous bases	—	—
Total	0·0400	100·00

Cultivation and fertilization have a very marked influence not only upon the yield of cane, but upon the composition of the juice. Stubble and non-fertilized cane, while giving a low tonnage, yield juices of higher sucrose content and better purity than canes from planted and fertilized areas. The juice from stubble and non-fertilized canes usually shows a marked deficiency in both ash and nitrogen, the deficiency in nitrogenous bodies, however, being limited more to the amids than to the albuminoids. The composition of the juice from the cane will also vary greatly according to the pressure of the rollers during the milling. The following experiment with a nine-roller mill using dry extraction will illustrate this very clearly.

TABLE VIII.

Composition of Juices from different Mills.

	Per cent. of Cane.
Extraction, First Mill	64·50
,, Second Mill	5·50
,, Third Mill	2·13
Total extraction	72·13

	First Mill.	Second Mill.	Third Mill.
Degrees Brix	15·36	14·60	14·60
Sucrose	12·93	11·41	11·30
Reducing Sugars	1·54	1·29	1·23
Ash	0·37	0·58	0·77
Nitrogenous bodies	0·18	0·50	0·58
Free Acids	0·10	0·11	0·14
Combined Acids	0·14	0·15	0·12
Pectin and Gums	0·10	0·56	0·51
Coefficient of Purity	84·07	78·15	77·39
Glucose Ratio	11·91	11·30	10·88

The juice from the second and third mills, where the pressure is the greatest, contains a much higher quantity of gums, albuminoids, and mineral matter, with a corresponding reduction in the coefficient of purity.

(*To be continued.*)

THE CHEMICAL COMPOSITION OF MOLASSES AND ITS VALUE FOR FEEDING STOCK.

By M. Aulard.

(Read at the International Congress at Liège.)

In reply to a lengthy paper by M. G. Mullie, veterinary inspector to the Belgian Agricultural Society, entitled "The value of sugar for feeding stock," I wrote as follows in May, 1904, "The aim of the sugar fabricant should be either to produce crystals, with little or no molasses, or to dispose of his molasses through the distillery; all the by-products being utilised for feeding stock."

When the price of sugar fell (to barely 15 frs. for 88° crystals, in March, 1904) we wisely endeavoured to find a market for our by-products, which is a vexed problem. I, therefore, wrote: "It appears to me that by promoting the consumption of molasses as cattle food the critical condition of the sugar industry would not be diminished since our surplus stocks consist of sugar and not of molasses."

Following on the inferior beet crops of the past two years, but especially of 1904, the world's stocks have melted away as sugar melts in water, so that the price of this valuable article of food has again risen until, at one period, crystals were fetching 40 frs. in Belgium and 45 frs. in France. At these high prices the manufacture of an inferior quality of sugar, only suitable for feeding stock, has become impossible, whereas the manufacture of cattle foods containing molasses has developed under the influence of agricultural and scientific publications.

At one time "sucre dénaturé"* alone was used for fattening stock, including even rabbits. All kinds of vegetables, including carrots, were thus sweetened. So valuable a food is sugar that man himself can maintain and develop his strength on an exclusively saccharine diet. But owing to the scarcity and high prices of this foodstuff, the value of which cannot be denied, man alone was deprived of it or only consumed it to a limited extent, whilst his cattle eat it to satiety.

By a curious coincidence, only too common in commercial transactions and customs, the price of molasses in Belgium, when sugar was very costly, remained invariably at 14½ centimes per unit of contained sugar as determined by Clerget's method, whilst, in the case of sugar crystals, that unit amounted to from 45 to 39 centimes—or three times as much. Such anomalies being serious to our interests,

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* A low grade sugar to which was added 2% of crude salt, so as to be rendered unsuitable for human consumption, and therefore exempt from duty. It was mixed with various cattle foods.

I was led to enquire what could be done with our molasses and to give you such general advice as might enable you to tide over the temporary crisis of the beet sugar industry. But not to anticipate matters, let us return to the subject of feeding stuffs containing molasses.

The chemical composition of molasses being familiar to all present, it is sufficient to state that this is a food consisting mainly of hydrocarbons, the wholesomeness of which is proportional to its purity, and which has been efficiently sterilized by boiling and reboiling at temperatures above 100° C. Its constituents being also soluble render it capable of rapid absorption by the digestive organs. This product plays the part of an "osmogene" within the animal's body, those constituents which cannot be absorbed being discharged as "exosmose waters," very rich in nitrates of soda and potash, in chorine and in urea. These being returned to the soil restore those elements which the beetroot had borrowed during vegetative growth and the elaboration of the sugar which it contains.

The manufacture of molasses-foods enables the fabricants to sell their molasses at from 8 to 9 frs. instead of at 6·50 or 6·75 francs as received from the distilleries to-day, that is to say, an increase of 1·75 francs per 100 kilos. This, calculated on the weight of roots, constitutes a gain of 70 centimes per ton of beets which is by no means to be despised in these uncertain times.

Certain French sucreries, and even one of the principal sucreries in Belgium, which have been specially equipped for the economic production of molasses, have been very successful. Why should not we also succeed? Certain well-known feeding-stuffs containing molasses are excellent, but as they have been sufficiently advertised I need not mention them here.

Everyone knows the composition of molassine which contains from 36 to 38% of sugar absorbed by an inert material (moss) and costing 9 francs per 100 kilos. After deducting the cost of manufacture and of the moss, this price works out at about 21 centimes per unit of sugar, which is more satisfactory than the 14·5 centimes received from the distillers, the more so since they have reduced this price by adopting Clerget's method of determining the sugar.

Mixture of molasses with ground cocoanut fibre, earth-nut, linseed, sesame, malt, maize, bran, chaff, &c., are all wholesome and nutritive when honestly and judiciously prepared. Their average composition is somewhat as follows:—

Albumin	10 to 12%
Oil	1 ,, 2·25
Cellulose	7 ,, 9
Hydrocarbons	41 ,, 52 (containing from 33 to 35% sugar)

A more complete analysis is given below :—

		Digestible constituents.	
Moisture	14·00		
Mineral Matter	6·50		
Crude Cellulose	5·25	5·00	
Fatty Matters	2·00	1·80	Hydrocarbons containing 32% of sugar.
Albuminoids	18·50	15·50	
Non-nitrogenous Matters	53·75	52·00	
	100·00	74·30	

These products being sold at from 10·5 to 15 fr. according to composition, at a price of 13 fr. per 100 kilos, one may count on the average composition cited above. The price of molasses works out at 23·24 centimes per unit of sugar, which is no exaggeration; in fact, according to Kirchnu, Grandeau, Henneberg and Kellner, if 100 kilos of good hay are valued at 7·50 frs. 100 kilos of molasses are worth 9·52 frs. This year we have seen the price of hay rise to 8·50 and even to 9 frs., whilst molasses, which should have a corresponding value of 10·80 frs., is sold to the Distiller's Syndicate at from 6·60 to 6·80 frs. Is that reasonable?

For some years past dried milk-casein has been employed in Germany as a basis for a molasses fodder. The skimmed milk is heated to 45°C., and treated with an acid which precipitates the albuminoids. The latter are separated from the fluid whey, finely divided, and mixed with molasses. Who will deny the possibility of utilizing the albuminious matter in the water from the pulp-presses for the same purpose?

According to the *Louisiana Planter*, the production of a new cattle food is occupying much attention in America and the Colonies, several thousand tons of which have already been exported to Europe. This preparation, known as "Molascuit," is composed of molasses and dried megass, and is, in fact, an idea borrowed from the sugar fabricant of Europe where molasses was mixed with dried beetroot pulp.

I do not very well understand how the above-mentioned product is patentable; but, at all events, it is an ingenious method for inundating our markets with cane molasses, and it is necessary to watch its development in England and Europe.

The article in the *Louisiana Planter*, to which I have alluded, contains the following statement on the subject of the manufacture of molascuit: "The cellular matter of the megass, after the extraction of the juice by the mill, is converted into a spongy mass, capable of absorbing its own volume of liquid."

It is, however, known that in order to utilise this property, it it preferable to remove all moisture from the megass by heat, after which treatment it is capable of absorbing seven times its weight of molasses, the absorption being facilitated by heating the molasses to a relatively high temperature, whereby it is rendered more fluid. As thus made, molascuit has the appearance of a granular mass, comparatively dry, and suitable for shipment; but, as I understand, capable of fermentation owing to the high percentage of glucose is contains, its acidity, and low percentage of salts. Whether this be so or not, it is evident that the market for beet molasses is seriously threatened by this product.

It should be noted that cane molasses can be converted into alcohol, burnt as fuel, or used for feeding stock. Fortunately for us, the sugar it contains cannot be extracted as economically as is the case with beet molasses, which are almost free from uncrystallizable sugar. You are aware how I have predicted the final triumph of the extraction of sugar from our molasses, and that in 1884 and 1885 I wrote on the subject in the early days of the *Association des Chimistes de Sucrerie et de Distillerie de France et des Colonies*, a subject which greatly interests me still.

I shall not now repeat what I have stated on many occasions, amongst others at the Lille Congress, three or four years ago; I will only say a few words which may, perhaps, induce you to follow the lead of our foreign rivals.

Our president, M. Dupont, as also others of our colleagues here present, will tell you that the production of sucrate of lime of from 95 to 97·5 % purity is a very easy matter when the lime is properly burnt and finely ground; that the proportion of from 75 to 80 of lime per 100 of sugar is generally adopted to-day, and that the composition of the sucrate varies to the extent of from 16 to 17 of sugar and from 12½ to 14 of calcium oxide.

The numerous difficulties in the separation by the methods of Baker and Béthany have, perhaps, been sufficiently proved, as is also the case with the processes of Baeyrmann or Steffen. But, owing to their perseverance, all difficulties have now been overcome. With good lime and sound molasses, resulting from careful work, the simple process of producing the trisaccharate of lime in the cold is economical, and, consequently, to be recommended. To the sugar contained in the molasses it yields its natural value, whilst it returns to the soil those elements which are abstracted from it by the beetroot.

Of all the methods of extracting sugar from molasses, I shall only mention one, which had a certain vogue in Italy under advantageous fiscal laws.

The formation of sucrate of baryta in the cold, although very simple and effective and requiring no costly apparatus, yet involves a complication which is avoided in the manufacture of sucrate of lime. The cost of baryta being higher, it becomes necessary to regenerate this material if the process is to be at all economical. The sucrate of baryta is very granular, and of a purity of from 97 to 99 %, and can be easily decomposed by means of the purified gases from the boiler flues, and by means of which 95 % of the sugar in the molasses is recovered.

It is, therefore, unnecessary to establish lime kilns outside the sucrerie as in the Steffen process.

In addition to baryta, the Scheibler process for preparing the monobasic sucrate of strontia has been successfully employed in Germany. Also, the precipitation of the sugar in the form of bibasic sucrate of strontia was installed in the Dessau sucrerie by Fleischer in 1891. The processes devised by Manoury and Tostmann have also been employed.

Of all these processes, only two have survived as practical methods in the sucrerie, and of these the strontia process of Scheibler developed into an independent industry.

Besides these methods of combination, wherein the sugar plays the rôle of an acid, I ask myself whether there has not been a simpler method which found favour in times past. It is undeniable that the processes of Steffen, Baeyrmann, Baker, and Béthany entailed a costly instalment, long experience in the management of the lime-kilns, an exceptionally pure limestone, and much experience of many delicate operations.

If the price of sugar were always as high as during the last campaign, it would always be advantageous to manufacture sucrates; but, unfortunately, it is not always so, and the usines cannot afford to spend a hundred thousand francs on an installation which would possibly lie idle during the coming campaign, if the price of sugar per unit of the crystals is only a few centimes higher than the price per unit in the molasses. What is wanted in the sucrerie is an economic and practical process, costing little to instal, and capable of being brought into use from time to time without the necessity of employing additional labour. In the osmogene of Dubranfaut, we have such a process, and the only one known for increasing the recovery of sugar from the beet without chemical treatment.

With an outlay of about 15,000 frs. at most, a usine working up 30 millions kilos of root could be equipped for extracting half of the sugar left in the molasses. Assuming that for every 100 kilos of crystals there are formed four kilos of molasses, the total output of molasses will contain 570,000 kilos of sugar. Half of this quantity, or 285,000 kilos, could be recovered by the use of two powerful osmogenes leaving the balance of the sugar, and the whole of the saline impurities in the final molasses and exosmose-waters.

I shall not enter upon the theory of osmosis which must be familiar to you all, but shall merely call your attention to the improvements made in this process as regards the apparatus itself, and also the manufacture of the parchment dialysing paper. The latter has been brought to such a degree of perfection that the defects experienced in the past need not be feared to-day. Formerly, osmosis was applied to the second and third jet molasses at the close of the manufacturing season. To-day we can obtain molasses five or six days after the factory operations have commenced, so that osmosis can be applied to molasses which are purer, more limpid, and much less coloured than was formerly possible. Under these conditions the salts diffuse through the parchment membrane more freely; the water used is purer and can be used at the boiling point. Finally, the very pure syrup yielded by this process can be boiled along with the first jet masse-cuite, thus yielding a single class of crystal and a well exhausted molasses which can be retreated in the osmogene after three days instead of after six or seven weeks.

All the exosmose waters can be evaporated to form a liquid manure, rich in nitrate of potash by utilizing Kestner's evaporating apparatus which I described in detail at the Arras Congress last year. This apparatus is very economical and does not occupy much space.

I am convinced that we ought not to be misled by fancy prices which we shall never see again ; prices which are detrimental to the consumption of this precious commodity, and which arrest the enthusiasm of those who are to-day studying the problem of how to extract the maximum quantity of sugar from the beetroot. Believe me, those who again take up this very interesting question of osmosis as applied to the more rapid work in the modern sucrerie will find that a considerable profit can be derived. The cost of a single osmogene amounts to about 1 fr. per 100 kilos of molasses treated. In the case of a sucrerie producing 4 kilos of molasses per 100 kilos of crystals, the cost of working per ton of roots will amount to 40 centimes in the case of a single osmogene and an additional 24 centimes for two osmogenes. In other words, at a cost of 64 centimes we can recover 50% of the sugar contained in the molasses; or 48 × ·50 = 24 kilos. Admitting that four kilos of molasses are produced per 100 kilos of roots, we therefore recover 24 × ·04 = 0·96 of sugar from the roots, or very nearly an additional one per cent. This costs us 64 centimes to extract, but sells at 2·50 frs. we therefore have a gain of 1·86 frs. per ton of beets by not selling our molasses to the distillery.

As the concentrated exosmose waters may be sold directly as manure to the cultivators, the large quantity of nitrogen which it contains is not run to waste as is done in the distilleries to-day. Or the same may be mixed with the final molasses, and sold as molasses for feeding stock.

Osmosis, properly carried out, will reduce the output of European molasses by 50 %, and recover an additional 1 % of sugar from the beetroot at a much lower cost than that at which we extract to-day.

You will note, gentlemen, that I have examined the problem from all sides, and in drawing your attention to osmosis to-day, I do not deny the possibility of a more perfect method of separation.—(From the *Bulletin de L'Association des Chimistes.*)

THE CUBAN SUGAR INDUSTRY.*

By W. D. Horne, Ph.D.

(Continued from page 258.)

In all the modern factories filter presses are now used for treating precipitates and scums. This muddy mass is diluted with tank washings in special blow-ups, rather heavily limed and heated to near the boiling point. After settling, the clear liquor is withdrawn and the muddy bottoms pumped through filter presses, having iron frames and jute or cotton cloths. It is difficult to wash the sugar out of the cake with either water or steam, and the best way to reduce the sugar is to dilute the scums sufficiently before filtering. The press cake is a good fertilizer, but in many cases it is thrown away. It contains 60 per cent. of water and from 6 to 12 per cent. of sugar.

The clarified juice is always concentrated in a multiple effect evaporator from about 9° or 10° B. up to 20° or 30° B., before being taken into the vacuum pan. The usual multiple effect for concentration *in vacuo* is a standard triple effect of one type or another. In the lower part of these upright cylindrical vessels are a large number of vertical tubes of about 1 in. diameter, and 3 ft. to 5 ft. long, their ends expanded into tube sheets. The space among the pipes and between the tube sheets constitutes the steam heating chamber, while the juice, admitted to the lower part of the effect rises through the tubes, is rapidly boiled and its vapour passes into the steam chamber of the second effect. The vapour arising from the boiling juice in the second effect is lead into the steam chamber of the third effect. The vapour space of the third effect is connected with a vacuum pump maintaining in the third effect a vacuum of 26 ins. or 27 ins., as represented by the gauge. In this effect the juice is densest and the temperature of the heating steam the lowest, necessitating this high vacuum to effect evaporation. The vacuum in the second and first effects stands at about 16 and 5 respectively. The steam chamber of the first effect receives exhaust steam at a pressure of 10 or 5 lb., or less. The juice valves are carefully set, so as to allow the juice to pass gradually from one effect to another, while a pump removes the water of condensation from the steam chamber through suitable traps. Various other types of multiple effect evaporators are also in use, among them the Lillie evaporator, in which film evaporation is effected. Here the juice is evenly distributed over a great number of 3 in. horizontal pipes internally heated by steam. As the juice trickles down over these tubes in thin films evaporation is very rapid. The vapour from the juice evaporated in the first effect becomes the heating medium for the second, and so on. The juice is passed continuously from one effect to the other by means of centrifugal pumps driven by Westinghouse engines having a speed of about 300 revolutions per minute. Instead of a vacuum pump a Bulkley condenser is used working on the same principle as the Korting injector or the Sprengel air pump. The Lillie evaporator requires great care, and must be reversed frequently to prevent incrustation of the tubes.

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* **Read at a meeting of the New York Section of the Society of Chemical Industry.**

A common fault in Cuba is the failure to carry this preliminary concentration far enough. The best density to concentrate to is 30° or 32° B., anything less than this throwing unnecessary work upon the vacuum pans, which require nearly three times as much heat to evaporate a pound of water as the triple effect uses.

The usual vacuum pan in use is an iron pan of upright cylindrical shape, fitted with about six or eight copper steam coils varying from 3 ins. to 5 ins. in diameter placed one above the other in the bottom part of the pan. It is usually arranged so that the lower coils can receive live steam, and the upper coils either live or exhaust steam. Some of the newer pans are of copper, and 12 ft. or 13 ft. in diameter, while the older ones are usually smaller, 8 ft. to 10 ft. being common. Vapours from the vacuum pan are condensed in a water spray condenser, usually connected with a dry vacuum pump, and a Torricellian water column. Frequently a central condenser serves for several pans. On account of the relatively low position of the pans in most Cuban factories it is common to build the condenser high in the air, outside, with the vapour, water and vacuum pipes all leading up to it, while the barometrical water column pipe drops from it to a water overflow tank below. Water is so scarce in the island that it is usually necessary to use the condensing water over and over. This necessitates the repeated cooling of the water as it flows from the condenser, which is effected by discharging it upon the top of the cooling tower, a succession of slat floors placed one above the other at the distance of 3 ft. or 4 ft. The water is so broken into spray that evaporation cools it down to about 90° or 95° F., at which temperature it is used again.

The methods of "boiling sugar," as it is called, or extracting all the sugar possible from the juice are very numerous, for nearly every factory has its own modifications, introduced on account of the exigencies of apparatus, juice, and so forth. The most direct way, and one followed in some places, is to boil the thickened juice or "meladura" to grain in the vacuum pan, discharge the thick massecuite into iron sugar wagons holding about 20 cb. ft. each, allow it to stand about a day until it has cooled to about 105° or 110° F., and purging it in centifrugals to obtain a first or centifrugal sugar polarizing about 96, and a first molasses with a purity of about 58 to 60. This first molasses is then boiled by itself to string proof, that is, until it is very thick, but free from crystals and of such consistency that it can be pulled out into a string between the fingers. This stands about a week in wagons to crystallize as it cools, and is purged in centrifugals, yielding a second or molasses sugar and a residual molasses having a purity usually of 40 to 45. However, it is found more advantageous to begin boiling a pan of second sugar with thick juice and to build thus a grain in the pan, on which the first molasses, which is subsequently taken in, will deposit a good portion of its sugar so that one more thoroughly exhausts the molasses. This masse-cuite requires a shorter time, about three days, for cooling and crystallization in the sugar wagons. Instead of starting the second sugar with thickened juice, some prefer to hold back a small part of a panful of first masse-cuite on which to build with first molasses, for in the masse-cuite the grain is already formed. Some factories, too, boil an intermediate grade of sugar by starting with about half a charge of thick juice or first masse-cuite, and finishing with first molasses, washing the resultant sugar with a little water in the centrifugals to raise it to 96 polarization.

The progressive factories are provided with crystallizers for receiving the masse-cuite directly from the vacuum pan. Masse-cuite is frequently forced from pan to crystallizer through an 8 in. to a 12 in. pipe by compressed air. The Westinghouse air compressor is very good for this purpose. The crystallizers are merely great tanks usually built in the shape of a horizontal cylinder 8 ft. in diameter by 20 ft. to 28 ft. long, and provided with an internal longitudinal shaft on which slowly revolves a helical stirrer which keeps the stiff mass in motion, affording better contact between the sugar crystals already formed and the molecules of sugar held dissolved in the mother liquor. This "crystallization in motion" as it is called, is a marked advance upon the older process of allowing crystallization to continue in wagons. Besides the better contact the cooling is more rapid, and this may be still further hastened by proper water-jacketing or by exhausting the hot vapour either with a blower or by a vacuum pump.

First magmas are purged within a day after being boiled, in some cases almost immediately, for if it is to be purged hot the magma can be boiled very dry, so as to contain only 8 per cent. of water. Second magmas usually crystallize well in three days in crystallizers, and it is possible by means of them to exhaust the molasses more thoroughly than by quiet crystallization, as shown by the low purity of such residual molasses.

The centrifugals used for purging the sugar crystals from the mother liquid are of the Weston or of the Hepworth type, in the older factories, 30 ins. in diameter, in the newer, 40 ins. Most of the machines are belt driven, but the water drive is used in a few factories. The latter is more delicate in its adjustment, and apparently more difficult to keep up to the desirable speed of 800 revolutions per minute, but it dispenses with much driving gear, and is very simple to operate. Some electric, directly driven, centrifugals are also in use.

From the centrifugals the sugar drops through hoppers directly into bags, usually holding 325 lbs., is accurately made up to this figure, and the bag sewn up, numbered, branded with the name of the estate, and shipped or stored for shipment.

Following are a few analyses of typical Cuban raw sugars:—

Grade.	Pol.	Ash.	Water.	Glucose.	Organic.
Centrifugal	97·00	0·32	1·40	0·52	0·76
,,	94·30	0·63	1·01	1·74	2·32
,,	94·50	0·61	1·21	1·79	1·89
,,	95·10	0·67	1·37	1·15	1·71
,,	94·50	0·60	1·53	1·47	1·90
,,	96·10	0·57	0·73	1·36	1·24
Molasses	89·10	2·21	2·78	2·22	3·69
,,	89·80	1·40	2·87	2·08	3·85

Large quantities of sugar are stored in the principal Cuban ports for shipment after the sugar crop is past, and such sugars are apt to ferment, causing a loss of several degrees in polarization. Such a case is well illustrated in the following analysis of raw sugars received at a refinery here through the year from a single estate, and all of the same polarization (within a tenth of two) originally:—

	January, 1905.	February, 1905.	March, 1905.	August, 1905.	December' 1905.
Pol.	96·30	96·40	96·10	95·30	93·50
Ash	0·46	0·54	0·56	0·50	0·51
Water	1·02	1·11	1·21	1·10	1·27
Glucose	1·11	0·76	0·91	1·44	2·98
Organic	1·12	1·19	1·22	1·66	1·74

The residual molasses is often sold to local distillers for about two or three cents a gallon; a little is burned on the bagasse and more is run out into streams, or even spread upon the land. Very little is exported. Following are a few analyses:—

Samples.	*a*	*b*	*c*	Analysis of ash. Per cent.	
				Fe & Al,	0·85
Pol. (direct)	35·8	28·60	31·80	Ca	9·60
,, Clerget	40·85	35·40	31·96	Mg	0·56
,, by inverson	—	35·72	—	K	28·34
,, Sawyer's method	—	27·50	—	Na	2·95
				SO_4	9·86
Ash	6·96	—	15·54	Cl	10·32
Water	25·27	20·84	18·92	PO_4	6·06
Glucose	15·70	—	13·33	SiO_3	3·21
Organic	11·22	—	20·25	CO_3	24·18
				H_2O	0·79
				Undetermined	3·28
					100·00

A useful by-product has been developed of late in the form of a cattle food called "Molascuit," formed by drying and shredding bagasse and then mixing it with as much thick molasses as it will hold. Such a product, upon analysis, showed the following composition:—

	Per cent.
Moisture	29·42
Fibre, crude	20·93
Sucrose	26·05
Glucose	6·06
Organic non-sugar	9·27
Ash, soluble	7·76
,, insoluble	0·51
	100·00

Some efforts have been made also to utilize the fibre of bagasse for paper making, but this has not yet been adopted in Cuba.

As the idea of scientific control of the manufacturing operations gains ground in Cuba, the chemist is coming to the front, and the superintendence and management of the factory is entrusted to him rather than to the chief sugar boiler as formerly. The modern chemical superintendent, through continuous systematic samples promptly analysed, and through constantly kept records in every department of the work, is able to see the correlation of its parts far more clearly than before.

Future advance in this great industry will depend upon the close adherence to scientific methods of investigation and control, and judging from the progress that has been made thus far, it is easy to believe that Cuba will always hold her place as one of the foremost sugar producers of the world.

CONSULAR REPORTS.

GREECE.

Corfu.—Imports of sugar from Trieste and Italy:—1903, 255 tons; 1904, 230 tons; 1905, 240 tons.

NORWAY.

In 1902 the imports of sugar amounted to 37,554 tons; in 1903, 37,886 tons; in 1904, 34,791 tons; in 1905, 35,320 tons. Since the sugar duties were lowered in 1891 and 1892 the consumption of sugar has increased on the whole, and the above official figures from 1902 onwards do not represent fully the total amount imported, as the sugar used for the manufacture of condensed milk exported during each year is deducted therefrom. The drop in 1904 is ascribed to a rise in prices and probable large stocks in hand. Of the sugar imported in 1904, about 30,000 tons came from Germany, 2,100 tons from the Netherlands, and 1,540 tons from the United Kingdom.

Imports:—

Articles.	Average for 1901-05. Tons.	1904. Tons.	1905. Tons.	1904. £	1905. £
Sugar	36,474	34,791	35,320	474,507	556,317
Syrup	12,890	12,465	12,035	83,107	79,133

PORTUGAL.

Beira.—The export of sugar from the Zambezi declined slightly during 1905, the actual output reaching 6,095 tons or nearly 1,000 tons less than in 1904.

This important industry, which will, it is believed, have a considerable influence in shaping the destinies of the Zambezi Valley, continues to attract attention, and another important plantation on the south side of the river at Chimbué in the Mozambique Company's territory is projected. This undertaking has received a concession of 12,500 acres of land on the condition that by June 1st, 1908, it is capable of manufacturing 8,000 tons of sugar yearly.

On the Lower Zambezi, which year by year grows shallower and more and more unreliable as a waterway, there are on both sides immense expanses of land in every way suitable for the cultivation of the sugar cane, and it is probable that in years to come this industry will be very extensively pursued in this favourite region.

PUBLICATIONS RECEIVED.

We are indebted to Messrs. Henry Tate & Sons, Limited, for a copy of a Chart compiled by Mr. L. A. Martin, which shows the imports of refined sugar, raw sugar, total of kinds, and proportion of refined each year, as well as the highest and lowest prices of Tate's Cubes and 88% Beet, from 1860 to 1905 inclusive. The whole is very well designed, and will prove a most useful addition to one's sources of information.

MONTHLY LIST OF PATENTS.

Communicated by Mr. W. P. THOMPSON, C.E., F.C.S., M.I.M.E., Chartered Patent Agent, 6, Lord Street, Liverpool; and 322, High Holborn, London.

ENGLISH.—APPLICATIONS.

6009. T. DROST, London. *Improvements in mashing apparatus for promoting the crystallization of sugar masses and for intimately mixing other pulpy masses with diluting agents.* (Complete specification.) 12th March, 1906.

7046. W. SCOTT, London. *Improvements in, and apparatus for, the manufacture of sugar.* 23rd March, 1906.

8291. H. W. Aitken and W. Mackie, Glasgow. *Improvements in and connected with sugar-cane mills.* (Complete specification.) 6th April, 1906.

8824. R. Harvey, Glasgow. (Communicated by J. P. Rodriguez, Cuba.) *Improvements in and relating to mills for crushing sugar cane or like material.* 12th April, 1906.

10278. C. Schuler, London. *Improvements in or relating to centrifugal machines for clarifying and washing sugar and similar materials.* (Complete specification.) 2nd May, 1906.

ABRIDGMENTS.

4449. C. D. Ehret, Pennsylvania, United States of America. *Improvements in centrifugal machines.* 3rd March, 1905. This invention relates to a centrifugal machine of the basket type, characterized by the fact that the electric driving mechanism is mounted directly within the basket itself, and that the central element of the said mechanism is maintained non-rotably on its vertical shaft, while the outer and rotable element is surrounded by and secured to the circular basket for the purpose of rotating the same.

26334. A. Vosskohler, Egeln, Germany. *Improvement in machine for making sugar goods.* 18th December, 1905. This invention relates to a machine for making sugar-ice goods, characterized by the fact that, in uninterrupted action, the moulds lying one above the other in a receptacle are one after another, advancing by jerks, brought first under a filling apparatus, filling the moulds through a sieve device, and then, after passing under an evening device and a smoothing roller and a press which shapes the material, are removed from the latter, whereby the periodical movement is caused by the weight of the filled mould.

Note.—Copies of all published specifications with their drawings in these lists can be obtained from W. P. Thompson & Co., 6, Lord Street, Liverpool, at One Shilling a copy for English or American Patents, and Two Shillings for German. In ordering please give number and date.

Patentees of Inventions connected with the production, manufacture and refining of sugar will find *The International Sugar Journal* the best medium for their advertisements.

The International Sugar Journal has a wide circulation among planters and manufacturers in all sugar-producing countries, as well as among refiners, merchants, commission agents, and brokers, interested in the trade, at home and abroad.

IMPORTS AND EXPORTS OF SUGAR (UNITED KINGDOM)

To end of April, 1905 ard 1906.

IMPORTS.

Raw Sugars.	Quantities.		Values.	
	1905. Cwts.	1906. Cwts.	1905. £	1906. £
Germany	780,219	3,202,428	556,982	1,356,614
Holland	74,389	38,077	54,731	14,341
Belgium	267,706	194,445	202,018	78,983
France	45,967	153,089	35,799	65,420
Austria-Hungary	210,908	108,561	157,356	45,225
Java	1,079,222	87,992	819,546	41,466
Philippine Islands	....	....	....	....
Cuba	....	111,910	....	41,943
Peru	559,248	300,320	421,933	137,359
Brazil	24,974	749,295	16,657	287,920
Argentine Republic	....	....	....	....
Mauritius	111,623	30,769	63,142	12,068
British East Indies	43,717	....	24,310	....
Straits Settlements	74,536	29,113	38,039	12,412
Br. W. Indies, Guiana, &c.	491,983	575,684	433,357	341,980
Other Countries	368,542	55,652	279,739	26,261
Total Raw Sugars	4,133,034	5,637,335	3,103,609	2,461,992
Refined Sugars.				
Germany	2,950,160	3,574,160	2,554,150	2,030,673
Holland	454,481	905,043	405,508	537,101
Belgium	104,976	107,380	92,159	62,433
France	387,769	674,577	339,338	374,977
Other Countries	181,789	10,048	151,560	5,070
Total Refined Sugars	4,079,175	5,271,208	3,542,715	3,010,254
Molasses	760,489	834,155	165,381	166,917
Total Imports	8,972,698	11,742,698	6,821,705	5,639,163

EXPORTS.

British Refined Sugars.	Cwts.	Cwts.	£	£
Sweden	84	127	73	114
Norway	7,307	5,877	6,212	3,574
Denmark	21,700	33,458	17,439	17,005
Holland	24,682	25,792	21,076	15,124
Belgium	1,686	3,314	1,326	1,706
Portugal, Azores, &c.	5,166	13,592	4,200	7,330
Italy	394	13,413	320	7,013
Other Countries	69,309	205,254	66,651	131,314
	130,328	300,827	117,297	183,180
Foreign & Colonial Sugars				
Refined and Candy	5,596	8,167	5,558	5,310
Unrefined	14,430	86,176	12,161	45,355
Molasses	403	4,771	193	1,498
Total Exports	150,757	399,941	135,209	235,343

UNITED STATES.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1906. Tons.		1905. Tons.
Total Receipts Jan. 1st to May 17th ..	799,667	..	772,013
Receipts of Refined ,, ,, ...	975	..	648
Deliveries ,, ,, ...	817,007	..	708,539
Consumption (4 Ports, Exports deducted) since January 1st..	636,780	..	580,810
Importers' Stocks May 16th	41,193	..	57,414
Total Stocks, May 22nd	366,000	..	277,350
Stocks in Cuba, ,, ...	327,000	..	362,000
	1905.		1904.
Total Consumption for twelve months ..	2,632,216	..	2,767,162

CUBA.

Statement of Exports and Stocks of Sugar, 1905 and 1906.

(Tons of 2,240lbs.)	1905. Tons.		1906. Tons.
Exports	550,449	..	559,797
Stocks	385,238	..	328,130
	935,687	..	887,927
Local Consumption (four months)	15,130	..	15,540
	950,817	..	903,467
Stock on 1st January (old crop)	—	..	19,450
Receipts at Ports up to April 30th	950,817	..	884,017

Havana, April 30th, 1906. J. Guma.—F. Mejer.

UNITED KINGDOM.

Statement of Imports, Exports, and Consumption for Four Months ending April 30th.

Sugar.	Imports. 1904. Tons.		1905. Tons.		1906. Tons.	Exports (Foreign). 1904. Tons.		1905. Tons.		1906. Tons.
Refined	274,248	...	203,959	..	263,560	386	..	280	..	408
Raw	250,924	..	206,652	..	281,867	1,739	..	721	..	4,309
Molasses	26,010	..	38,024	..	41,708	5	..	20	..	239
Total	551,182	..	448,635	..	587,135	2,130	..	1,021	..	4,956

	Home Consumption. 1904. Tons.		1905. Tons.		1906. Tons.
Refined	292,711	..	195,190	..	244,235
Refined (in Bond) in the United Kingdom	172,758	..	158,213	..	178,962
Raw	42,500	..	29,278	.	36,670
Molasses	26,320	..	37,827	..	40,895
Molasses, manufactured (in Bond) in U.K.	21,601	..	17,717	..	23,103
Total	555,890	..	438,225	..	524,565
Less Exports of British Refined	9,046	..	6,516	..	15,041
Total Home Consumption of Sugar	546,844	..	431,709	..	509,524

STOCKS OF SUGAR IN EUROPE AT UNEVEN DATES, MAY 1ST TO 19TH, COMPARED WITH PREVIOUS YEARS.

IN THOUSANDS OF TONS, TO THE NEAREST THOUSAND.

Great Britain.	Germany including Hamburg.	France.	Austria.	Holland and Belgium.	TOTAL 1906.
181	1201	648	579	233	2843

	1905.	1904.	1903.	1902.
Totals	1993 ..	2548 ..	2523 ..	2631

TWELVE MONTHS' CONSUMPTION OF SUGAR IN EUROPE FOR THREE YEARS, ENDING APRIL 30TH, IN THOUSANDS OF TONS.

(Licht's Circular.)

Great Britain.	Germany.	France.	Austria.	Holland, Belgium, &c.	Total 1905-06.	Total 1904-05.	Total 1903-04.
1714	986	623	501	179	4003	4018	3955

ESTIMATED CROP OF BEETROOT SUGAR ON THE CONTINENT OF EUROPE FOR THE CURRENT CAMPAIGN, COMPARED WITH THE ACTUAL CROP OF THE THREE PREVIOUS CAMPAIGNS.

(From Licht's Monthly Circular.)

	1905-1906. Tons.	1904-1905. Tons.	1903-1904. Tons.	1902-1903. Tons.
Germany	2,425,000	1,598,164	1,927,681	1,762,461
Austria	1,510,000	889,373	1,167,959	1,057,692
France	1,085,000	622,422	804,308	833,210
Russia	1,000,000	953,626	1,206,907	1,256,311
Belgium	330,000	176,466	209,811	224,090
Holland	210,000	136,551	123,551	102,411
Other Countries	410,000	332,098	441,116	325,082
	6,970,000	4,708,758	5,881,333	5,561,257

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☞ The Editor is not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

NOTES AND COMMENTS.

The Government and the Sugar Convention.

The leading article in our last number entitled "Mr. Lloyd-George on Sugar" has, we are glad to see, not escaped notice in responsible quarters. In fact we have good reason for knowing that the Minister in question has himself read "with great interest" the criticisms on his attitude to the Sugar Convention. As Sir Edward Grey and Mr. Asquith have likewise been placed in possession of the facts as given of late in our Journal, it should be clear that the Government cannot any longer plead ignorance as an excuse for wrong action or false premises. For the present, however, all their interest is centred, as we expected, in home legislation, which promises to place them in a tight corner, and we do not anticipate any further attempts this session to have a debate on the sugar question. Prices remain low (8s. 3d. to date), and imports of beet, raw and refined, show a substantial increase, so that little ground exists just now for fomenting fresh agitations.

The Position of Brazil in the Convention.

It will be a matter of common knowledge to our readers that till just lately Brazilian sugar had been for some little time under a cloud, as it were. Brazil was accused before the Brussels Commission of giving a bounty on her sugar, and at first the charge seemed proved and she was condemned. Furthermore, her name was not included amongst those other states against whose condemnation Great Britain entered an appeal. It was, therefore, difficult to reopen the question, but the British delegates, to their great credit, succeeded in doing so. Extensive enquiries were then set on foot, and though at first our representatives' view was but "a voice crying in the wilderness," they stuck to their original opinion, and gradually wore down the opposition. The result is, the charge against Brazilian sugar has now been definitely withdrawn and it is free to enter this country. This decision is entirely the result of the skilful diplomacy shown by Sir Henry Bergne and Mr. George Martineau, which, apart from the benefit accorded to Brazil herself, has rescued this country from an awkward position that might have gone far to imperil the successful working of the Convention. As it is, we owe these gentlemen a debt of gratitude for their unstinted labours. As to the Brazilians, they are very pleased with the result, but we trust they are fully aware that, had not our delegates kept the question open till their expert deputation arrived on the scene at Brussels, their cause would in all probability have been condemned unheard.

Alcohol for Industrial Purposes.

Little headway seems to have been made in the United Kingdom in the agitation for a duty-free alcohol for industrial purposes. A Royal Commission sat recently on this subject, but nothing material has been the outcome of it all. For the present there is little chance of our having a measure allowing the sale of denatured alcohol free of duty; the utmost we can expect is a more or less substantial reduction. This will of course benefit the chemical industries engaged in colour-making (dyes), extraction of natural oils and essences, and soap manufacture. But the very much larger field of motor engines which at present depends on petrol (gasoline) will not be opened out until the price is sufficiently reduced to warrant a heavy preliminary outlay in experiments. The cheapest source of such alcohol is low grade molasses, and as its advantages over petrol are fairly well established, only the duty stands in the way of its practical use. While petrol costs from 10d. to 1s. 2d. per gallon in this country, alcohol might easily be retailed for 7d. or 8d., and might be manufactured in cane growing countries for 5d. a gallon. Even at the price of 9d. some progress in the use of industrial alcohol would be probable, but it seems clear that the distillers are themselves much to blame, as they demand an unreasonably large profit per gallon; and none of the motor industries will touch their spirit at the price they ask since petrol answers for their purpose at present. Once abolish the tax, and an inexhaustible supply of cheap alcohol would soon be available, for even when the whole of the low grade molasses is used up, it could still be produced from starch of any kind. A well-informed correspondent, who writes to us on this subject, says: "I do not think I am going too far in saying that any sugar manufacturer who can produce denatured alcohol in a tax-free country ought to put down plant to-day for the purpose. He must not wait a single day, and he need not wait to find out whether markets exist. A reasonably low cost to the consumer will *make* a market. The market of to-day is considerable, but nothing to what it will be shortly."

The principal objection to the abolition of the tax on alcohol when denatured seems to be the uncertainty as to whether the denaturation will be effective to prevent surreptitious consumption. In a country where so much of the revenue is derived from duties on wines and spirits consumed by the populace, it is not unnatural that hesitation should be shown to a proposal which might render a certain amount of untaxed spirit drinking inevitable. It is therefore probable that till tariff reform re-adjusts our basis of taxation, and lessens the importance of drink as a source of revenue, no satisfactory measure will be forthcoming.

The Sugar Beet Factory in Lincolnshire.

Some progress is apparent in the forwarding of the scheme for a sugar beet central factory at Sleaford, Lincolnshire. What is described as a very influential meeting was recently held to consider the question. Mr. Sigmund Stein gave an interesting address, and a discussion followed as to the cost of production. It was pointed out that co-operation of the farmers was absolutely essential to success, and that it would take at least some 25,000 tons of beet per annum to keep the factory going. The ultimate decision arrived at was to hold a public meeting early this month, and meanwhile to obtain as many names as possible of farmers who would be willing to enter into contracts to grow beet for a term of years. As to the capital required, it was considered that no difficulty would be experienced in finding it.

The largest sugar refinery in Pomerania, the Pommersche Provinzial Zuckersiederei, declared a dividend of only 10% in 1905, as compared with 20% in 1904, 22½% in 1903, and 30% in 1902.

The new Java crop has commenced in several districts and the reports are not very favourable. Owing to drought followed by floods the cane has suffered, so that both tonnage and sugar content are inferior to last year's figures. The total output of sugar will by no means exceed one million tons.

DRY LEAD DEFECATION IN OPTICAL SUGAR ANALYSIS.

(Extracts from a paper read at the VI. International Congress of Applied Chemistry, Rome, April, 1906).

Watts and Tempany publish results showing that the ordinary method of polarization gave, on muscovado sugars and partially refined products, results averaging 0·32° too high due to the error caused by the volume of the precipitate, while the use of anhydrous lead subacetate used for defecating by Horne's method gave results only 0·04° above the theoretical.

Messrs. H. & L. Pellet, however, still find some objection to the process, based on their opinion that there is a compensating error in the opposite direction caused by the absorption of sugar by the lead precipitate lowering the polarization. They do not give figures to show what the extent of this error is, but I have made experiments to ascertain whether any sugar is absorbed by the lead precipitate and get thoroughly negative results, as follows: I dissolved 52·096 grams of dry granulated sugar in water and made up to 200 c.c. Then 50 c.c. of this was made up to 100 c.c. and polarized 49·725 as the average of closely agreeing polarizations obtained by two observers. Another 50 c.c. were put into a 100 c.c. flask, 10 c.c. of optically inactive organic solution prepared from a previous lead precipitate was added and then 2 c.c. of sub-acetate of lead solution at 24° Brix, (being just enough to precipitate it) and finally water up to the 100 c.c mark. The whole was shaken, filtered and polarized, giving 49·80 by both observers, whereas the polarization calculated from the sucrose present and the volume of lead precipitate, by the method indicated by Messrs. Pellet, was 49·755. So here we have a direct refutation of the opinion that the lead precipitate absorbs sugar, for we find an apparently slightly higher amount of sucrose in the presence of the precipitate than before (even after calculating off the increase due to the volume of the precipitate) and not a lower amount. Fearing that the above amount of precipitate was too small to give reliable results I repeated the experiment, using 50 c.c. of sugar solution, 40 c.c. of organic solution, 8 c.c. of lead solution and water to 100 c.c. This time the original sugar solution, diluted, polarized 49·783, while that prepared with lead polarized 49·916 as against a calculated polarization of 49·903. These results appear to me to establish very thoroughly the fact that the lead precipitate does not occlude or carry down with it any sugar at all. Further, one gram of dry pulverized lead precipitate shaken vigorously for 15 minutes with 50 c.c. of a pure sugar solution of normal concentration in a small flask and then filtered did not lower the polarization in the least, both polarimetric observations being made by two observers. Before mixing, the readings were 99·80 and 99·85, and after mixing the readings were 99·85 and 99·85.

Having thus replied to this criticism of my method, I will record the results of my further investigation of the slight residual discrepancy between the theoretical polarization and that obtained by the dry lead method of defecation. In my original article I showed that the dry lead defecation overcame in low grade cane sugars about 84% of the error due to the volume of precipitate, but that still the results were a trifle above the theoretical, and I expressed the intention of further investigating this. It was evident that in the dry lead defecation there would be a very slight over-concentration, due to the small amount of insoluble matter existing in the raw sugar itself, which had not been taken into account in the dry lead polarization, but which had been taken into account in the corrected wet lead polarization.

Very careful experiments were conducted upon centrifugal, muscovado, and molasses cane sugars, determining in each sample of each grade of sugar the polarization by the ordinary method, the polarization by the dry lead method, the volume of the precipitate plus insoluble matter, the volume of the insoluble matter alone, and (by calculation) the theoretical polarization.

On the average, the centrifugals gave an ordinary polarization ·142° above the theoretical, while the dry lead polarization was only ·034° above theory, and when this was corrected for the insoluble matter in the sugar itself it fell to ·017° above theory.

The muscovadoes gave ordinary polarizations averaging ·193° above theory, dry lead polarizations only ·06° above theory, and this corrected for insoluble matter fell to ·03° above theory. The molasses sugars gave ordinary polarizations ·255° above theory, and dry lead polarizations only ·055° above theory, which on correction for insoluble matter fell to ·014° above theory. Thus while the ordinary polarizations on these sugars are from ·142° to ·255° too high, the polarizations by the method which I propose and advocate are only ·034° to ·06° above theoretically correct figures; and of this amount about half is due to the insoluble fibre, sand, &c., of the raw sugar itself, and the other half to some cause as yet unknown. Thus in both of my investigations, and in Watts' and Tempany's, the ordinary polarizations are shown to be about ·25° too high, while by defecation with dry sub-acetate of lead the polarizations are only about ·05° above theoretical. This method is such a marked improvement that it would seem to recommend itself unequivocally to all unprejudiced minds.

W. D. Horne.

NEW PATENT BEARINGS FOR SUGAR MACHINERY.

The Mirrlees Watson Co., Limited, of Glasgow, have secured the sole licence in this country for the manufacture by a new process of sugar machinery bearings for which a longer life, less friction, and greater economy are claimed. While not pronouncing any opinion on the superior merits claimed for this new process, we yet think it will be of interest to mention some of the comparative tests that have been undertaken with a view to demonstrating its success.

The above-mentioned firm are not, we understand, responsible in any way for the invention, but, having had it brought to their notice, they made a very full investigation, with such satisfactory results that they decided to take up the manufacture. The secret of the new process, it may be mentioned here, lies in the casting of the alloys, and applies to all bronzes, white metals, and to all copper, tin, and zinc alloys.

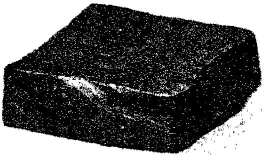

Fig. 1.—Untreated.

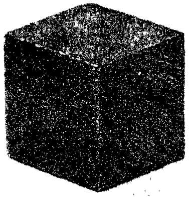

Fig. 2.—Treated.

The first tests carried out by this firm consisted in making a large number of bearings and test pieces of well-known alloys, such as phosphor bronze of different compositions, gun metal, and various white metals, including some well-known and widely used brands. These bearings were cast by them in various manners, some in ordinary sand moulds, some in iron moulds or chills, and some in water-cooled chills, &c. At the same time they cast from the same ladles ingots which were handed over to the inventor, and by him cast by his process and formed into bearings and test bars of the same dimensions as those cast by them. All were then subjected to various tests, and the results showed that the new process gave bearings superior in every way to those produced by the older processes. The friction was lower, the bearings worked with heavier loads, and carried the same loads for longer periods.

Among the comparative test results given we extract the following:—

Crushing tests were carried out on well-known antifriction metal, *untreated* and *treated*. ·75 inch cubes were subjected to a crushing strain. While both were subjected to the same load, the average untreated cube was reduced to ·334 inch, while the treated cube was only compressed to ·556 inch.

The illustrations (Figs. 1 and 2) show the results of this test. Both blocks were subjected to a pressure of 5·56 tons per square inch.

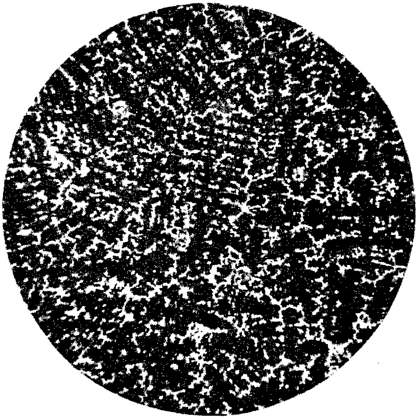

Fig. 3.—Treated.

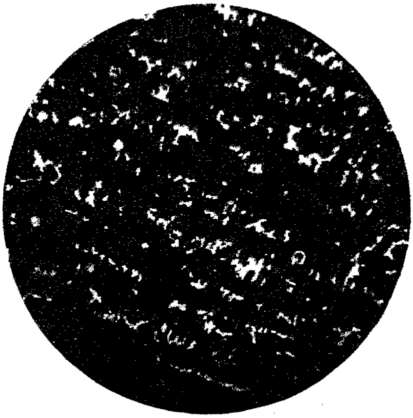

Fig. 4.—Untreated.

Running trials were also undertaken on various metal bearings, both *treated* and *untreated*, all under the same conditions of load and lubrication. Under the load imposed, the *untreated* metal entirely failed within an hour's run, by which time the temperature had risen 44° F. Under the same load and during the same length of time, the *treated* metal rose 34° F., and the *treated* bearings were kept at work until the temperature had ceased to rise, which took place in about four and a half hours. The test was stopped after five hours' running, as all the conditions were steady.

We likewise give reproductions (Figs. 3 and 4) of micrographic sections of the white metal as used in the bearings referred to above. Both sections were from material of precisely the same composition, but one sample has been treated by the new process.

THE INFLUENCE OF HEAT ON THE ROTATORY POWER OF LEVULOSE IN NEUTRAL AND ACID SOLUTIONS.

We have previously stated that a solution of levulose in pure water can be maintained at the boiling point for several hours without undergoing change. But when the levulose is dissolved in ordinary filtered water (such as the Paris water supply) and heated, the optical activity of the solution is reduced, whilst its reducing action on copper liquor remains unchanged.

The following results were obtained by M. Quillard. A solution of levulose was prepared, containing 1 gram. in 100 c.c. of distilled water. (An analysis of the levulose gave: Moisture, 0·07%; ash, 0·20%):—

Experiment.	No. 1. Before Heating.	No. 2. After Heating for 5 hours.	No. 3. 10 hours.	No. 4. 20 hours.
Polarization (constant)	15·6	15·6	15·6	15·6
Temperature	23·5	23·5	23·5	23·5
Volume required to reduce 5 c.c. copper liquor	5·2 c.c.	5·2 c c.	5·2 c.c.	5·4 c.c.

EFFECT OF 10% HYDROCHLORIC ACID.

	Before Heating.	After Heating for 5 hours.	10 hours.	20 hours.
Polarization (variable)	—16·4	—0·4	—0·2	—0·4
Temperature	29·5	29·5	29·5	26·0

Under the same conditions, a solution of dextrose (1 gram. in 100 c.c.) gave the following results. (The dextrose contained: Moisture, 8·95%; ash, 0·3%):—

	Before Heating.	After Heating for 5 hours.	10 hours.	20 hours.
Polarization	+10·0	+9·8	+9·7	+9·6
Temperature	23·5	23·5	23·5	23·5
Volume required to reduce 10 c.c. of copper liquor	6 c.c.	6 c.c.	5·95 c.c.	6 c.c.

EFFECT OF 10% HYDROCHLORIC ACID.

	After Heating for 5 hours.	10 hours.	20 hours.
Polarization	+7·4	+6·0	+5·0
Volume required to reduce 10 c.c. of copper liquor	5·45 c.c.	6·9 c.c.	7·2 c.c.

There is, therefore, a distinct reduction in optical activity, although less pronounced than in the case of levulose. As the polarization diminishes there is a corresponding variation in the reducing power.

The action of ordinary water on levulose was next examined and compared with that of distilled water; both solutions containing 1 gram. of levulose in 100 c.c. :—

	Distilled Water.	Ordinary Water.
Polarization before heating (using a French polarimeter and 400 m.m. tube)	15·6	.. 15·6
After heating for 12 hours in water bath	14·2	7·9
Polarization (Clerget) after heating	14·4	.. 8·0
Appearance of the heated solution	Colourless	.. Yellow

These results show that a solution of levulose, prepared with distilled water, is not appreciably affected by heating, as Mr. Deerr has also observed. But the solution prepared with ordinary water loses nearly 50% of its optical activity after heating for 12 hours. Moreover, the addition of hydrochloric acid and the Clerget inversion does not modify this rotation, as we have ourselves proved.

Now, in practice, levulose is heated in the presence of various substances, cane juice being a very impure liquid, and consequently the levulose undergoes change. This explains why the levulose in cane-molasses behaves differently to a pure solution of levulose.

The foregoing observations by MM. H. Pellet and C. Quillard explain the following points:—

1. Why the reducing sugars in cane-molasses possess variable optical activity.
2. Why optically inactive reducing sugars are present in molasses.
3. And why the direct polarization may differ very slightly from the polarization after inversion by Clerget's method (apart from the influence of subacetate of lead on levulose).

It is evident that since the sucrose content of molasses is unchanged by prolonged heating, the polarization will gradually rise if the levulose in the invert sugar has not been already modified during the evaporation of the juice and syrup.

It should also be observed that levulose gives a strongly coloured solution when heated in the presence of ordinary water. And it is also known that diluted cane-molasses, to which sugar has been added so as to raise the purity to that of the original juice, is much more strongly coloured than the latter. In our experiments, the colour of the diluted molasses was from 2 to 7 times as great as that of juice of the same purity; the colour intensity varying with the quality of the canes and with the method of working.

Hence, the less the alteration in the levulose the more pronounced is the colour of the molasses, and the greater the error between the direct polarization and the Clerget value. It is here assumed that all other conditions remain the same, since canes which contain the same proportion of reducing sugars per 100 parts of sucrose, will contain more or less levulose according to their relative maturity. Thus, when the canes are perfectly ripe and contain more dextrose than levulose (or, perhaps, very little levulose), the syrup and other products are much less strongly coloured, although they contain an appreciable quantity of reducing sugars consisting mainly of dextrose which is stable under ordinary working conditions.

Consequently, in the analysis of cane-products and, especially, of juice, syrup, and molasses, it is unnecessary to allow for the variable optical rotation of levulose in the presence of an excess of acid, as must be done when dealing with pure levulose.

We hope that Mr. Deerr will shortly confirm these observations.

H. PELLET.

DENATURED SUGAR.

By LEON PELLET (Chimiste).

By this name is understood in France a special product composed chiefly of crystallized sugar, mixed with a special "denaturent" consisting of salt (NaCl) and other simple substances.

According to the French law of July 5th, 1904, this "denatured sugar" is (as are denatured spirits) exempt from all duties. It is used as cattle food, and also for the brewery. The denaturation has to be carried out in the following manner:—

With 100 kg. of crystallized sugar, polarizing less than 95°, one mixes thoroughly (1) 2 kg. of salt (itself denatured or not), (2) 20 kg. of powder formed from alimentary oil-cakes. For the latter one can, however, substitute an equivalent quantity of meat meal, fish meal, fish guano, powdered peat, or dry exhausted pulp powder.

For the brewery one uses other denaturents.

Since the promulgation of this law denatured sugar has been much used. It had already for a long time been used in Germany and Austria. In France the demand for it had been voiced by a large number of agriculturists and chemists. Amongst them was M. Vivien, who has made a special study of the matter.

The high alimentary value of sugar is now too well known to need dwelling upon; but it is interesting to note that sugar foods are particularly suitable as fattening food for cattle.

For example, by giving daily to a cow or a horse one kg. of denatured sugar, and to a sheep 200 or 300 grammes, excellent results were obtained. At the present time this food costs about 22 or 23 fr. per 100 kilogrammes, but varies slightly according to the nutrient matter which is added to the sugar.

The consumption of the sugar is increasing every day in France, as is shown by the following table published by M. Vivien in the "Sucrerie Indigène et Coloniale," and completed with the figures for the last months:—

CONSUMPTION OF DENATURED SUGAR (CALCULATED IN REFINED SUGAR) IN KILOG.

	Brewery.		Cattle Food.	
	1904–05.	1905–06.	1904–05.	1905–06.
September	..	24,421	..	..
October	2,938	78,466	..	1,178
November	4,392	28,922	..	13,196
December	4,604	15,475	1,122	10,418
January	2,963	34,104	.	75,266
February	3,787	46,516	808	160,873
March	5,169	47,915	152	103,854
April	4,433	44,978	1,352	105,199
May	8,620	..	505	..
June	10,983	..	237	..
July	19,569	..	325	..
August	24,885	..	173	..
	92,343	320,797 (For 8 months.)	4,674	469,984 (For 8 months.)

It must be noted that 100 kg. of refined sugar are equal to 150 kg. of denatured sugar.

The real consumption is thus about 700,000 kg. for the first eight months of 1905–06, and for the first four months it was very small.

We are sure that this cattle food would give in England very good results for fattening stock.

NOTE.—We can undertake to send samples to any person interested in this question.

Exports of sugar from Odessa to the Far East are said to have practically ceased because of the successful competition of German exporters, who can send out their sugar on more favourable terms.

In one of the last speeches made by the late Mr. Richard Seddon, Premier of New Zealand, he said he was prepared to admit Australian sugar free into New Zealand, thereby sacrificing £186,000 of revenue per annum.

ON THE VALUE OF SUGAR IN CATTLE FEEDING.

Our attention has been called to some correspondence in the *Farmer and Stock Breeder and Chamber of Agriculture Journal* on the advantage to be derived from the addition of soft moist sugar (muscovado) and cane sugar molasses to the daily rations of farm stock, especially on dairy farms. It is well known how rapidly the live stock kept on our sugar plantations fatten up and improve after crop time commences, and they get the addition of cane tops and other saccharine waste with their daily rations.

We are aware of the introduction of "Molascuit" and "Molassine" as cattle foods. The former from cane sugar and the latter from beet sugar products. The sugar contained in these foods is virtually denatured and therefore has been very properly exempted from all duty. This is as it should be. But there is still room for a greater development of the principle of providing sugar for cattle feeding. In France we understand that steps are being taken to allow sugared cattle food to be prepared in bond so that the denatured sugar may be exempt from taxation.

It remains for farmers and stock-breeders to put to the test of experiment the suggestions contained in the following letter by "Ragus," which we have taken from the above-mentioned journal. All that remains is for farmers to order one hundredweight parcels of the cheapest soft moist cane sugar (muscovado) and give the same to their stock in the proportion suggested by the correspondent. After a trial for a month the results might be made known.

SUGAR AS A FOOD FOR LIVE STOCK.

Sir,—As soft moist cane sugars are now arriving from the West Indies and being sold at low prices, the attention of all dairy farmers and others should be given to the value of mixing a small quantity of this soft cane sugar with the rations of their cattle for improving the quality and increasing the yield of milk, an allowance of 1 to 2 lbs. of this sugar being sufficient for milch cows per head per day mixed with their rations. Sugar has also been used with most satisfactory results for fattening pigs, allowing each pig 1 to 1½ lbs. of sugar per day mixed with skim milk and barley meal. Pigs after a time eat sugar with relish and never seem to get tired of it. A reference to the authoritative work of L. S. Ware (Philadelphia, 1902) will prove from the records of several official experiments the immense value in cattle feeding of simply mixing with the food some cane sugar. If dairy farmers and others would only use some moist cane sugar or cane sugar molasses to mix with the rations of their cattle, horses, and pigs, and keep a record of the results, the value of cane sugar as an addition to ordinary food stuff would soon be manifest.—I am, &c.,

RAGUS.

THE MEYER & ARBUCKLE PATENT FILM EVAPORATOR.

We learn that the Patent Film Evaporator of Messrs. Meyer & Arbuckle is proving very successful. An existing triple effect at the Usine Palmiste, Trinidad, owned by Mr. Norman Lamont, M.P., was recently fitted with this apparatus, and the improvement in its working was to all appearances so marked that some account of it will not be without interest.

The triple as originally working had a steam pressure in the first drum of 10 lbs. per square inch above atmospheric pressure. The temperatures in the three vessels were respectively 200, 180, and 140 F., and the rate of evaporation per square foot of heating surface per hour was 4·8 lbs.

In the second instance, with the Meyer & Arbuckle apparatus added, the pressure of steam in the first drum was only 5 lbs. above atmospheric pressure, and the temperatures in the three vessels were respectively 182, 170, and 135 F., the rate of evaporation being 11·04 lbs. per square foot of heating surface per hour, an increase of 6·24 lbs.

It may be added that the trials were made at the end of the crop under exactly equal conditions of working, that is, with the sugar cane juice treated of the same density and the heating tubes in the triple in the same condition as regards cleanliness in each case. There seems no doubt that if the apparatus had been put to work at the commencement of the crop, when the heating surface in the effect was perfectly clean, the rate of evaporation of 11·04 lbs. per square foot per hour would have been materially increased.

The manager of the above-mentioned usine has expressed his full satisfaction with the new apparatus, asserting that they can now do more than double the work possible under the former conditions.

We need only point out in conclusion that the firm who executed the above order of fitting the Meyer & Arbuckle apparatus were Messrs. George Fletcher & Co., of Derby, to whom the signal success of their plant must be gratifying.

Two new private sugar factories are in course of erection at Behar, Bengal; this will make in all six factories at work in that district.

A great decline has taken place in the exports of Argentine sugar due to the abolition of the bounty formerly paid by the national Government on exported sugar.

THE CHEMICAL SELECTION OF SUGAR CANE.*

By J. D. Kobus (Java).

(Continued from page 305.)

In part these foregoing results are to be attributed to the fact that during the first selection plants whose small sugar content was only accidental, being occasioned by attacks of animal or vegetable parasites or other mischance, were nevertheless always classified as being poor in sugar. As no single trial was rejected in the calculation of the mean figures even if it was apparent that the poor group gave irregular results from the very commencement, we could not in this case expect the favourable results of the rich groups. Whether yet other factors have entered into the case must be settled by further investigations.

But in any case our results are of considerable importance for all cane sugar producing countries, since we have demonstrated that quite an appreciable increase in sugar output can be obtained at but small extra cost.

One cannot of course select all at once the several million cuttings required annually for a sugar plantation. Such a labour could not be achieved, all the more when it has to be undertaken at the same time that the harvesting of the old and the planting of the new crops taxes the capabilities of the whole factory staff. Besides that, the method would be pretty expensive as compared with the beet, since each mother plant only yields a few descendants.

If in the mean we reckon on a fourfold increase in each cane plant and in the space of four years would plant the whole acreage with the progeny of canes rich in sugar, then we should require for an average factory a quantity of about 200,000 cuttings, and since in carrying out a careful selection only the cuttings from the 10% of richest mother plants would be chosen, we should have to examine about half a million plants.

We therefore endeavoured to shorten the process of selection and succeeded in doing so to a noteworthy extent by means of the already mentioned correlation between sugar content and weight. By a comparison of several thousand analysis figures with the weights of their respective cane plants, we found that the richest half of the 20% of heaviest plants contained on an average 90% of all the plants richest in sugar.

It remained therefore to examine the 20% of heaviest plants of a field set apart for "selection" work, and it was soon apparent that this was the essential standard of selection, by which methods

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*Read at the Int. Congress of Applied Chemistry, Rome, 1906. Special translation for *I.S.J.*

involving much time might be dispensed with and which might be carried out by a native plantation overseer.

The number of plants that required to be examined was reduced to at least one-fifth and, since the large plants yielded more cuttings, even to a tenth part.

Consequently only 50,000 to 60,000 plants required to be tested in order to fill the whole plantation within four years with the descendants of selected canes. If one then takes, each year, the richest plants from a field laid out with selected cane and uses them for further selection, one will see the sugar percentage gradually mounting up, in the same manner as we perceived it to do in the course of our experiments.

But we found yet another way of simplifying the work. In Java it is customary to raise a fairly large proportion of the necessary cuttings in special fields, in order to make their planting to some extent independent of the period of the cane crop. Here the canes are not allowed to ripen, in order that the whole stalk may be utilized for cuttings; by this means two to three times as many cuttings are secured to the hectare as from a hectare of ripe canes.

We next succeeded in ascertaining that in the case of unripe canes of about 30 weeks old, there was a considerable difference in sugar percentage between the descendants of rich and of poor plants. It was thereupon possible in about 60 weeks to get doubly selected cane, as one first took from selected canes cuttings to plant the experimental fields with, and then, 30 weeks later, made a fresh selection from the young canes just grown.

One of my friends demonstrated that this selection is also easily carried out in practice. He began by selecting cane for the cuttings field of his factory, and ere long he succeeded, by using a polarimeter with a Pellet tube (such as was always employed by us), in investigating 2,100 heavy plants per diem. The cuttings from the half richest in sugar were planted out, and he was able to secure 200,000 kg. of selected cuttings within three months, sufficient for 50 to 100 hectares of cane. As a consequence, the whole plantation could be filled within the third year with the descendants of selected canes.

In the case of still younger plants of about 20 weeks of age, no difference in sugar content was found between the rich and the poor groups although the plants sprang from four-fold selected parents, and the corresponding experiments six months later yielded no less than 250 per cent. of variation.

In practice selection is easily carried out. The laboratory is installed in a bamboo hut close by the field reserved for selection. When the field is reaped, one moves on to another field. To erect and fit out the laboratory requires at the most two days, and to move it on only one.

The heavy plants coming in from the field (which had each to be tied up), were brought to the laboratory mills, of which latter we employed four. The cane tops intended for cuttings were then sliced off, and the sugar cane, as well as the cuttings taken from it which were bundled together, all received the same reference number. The cuttings were hidden in a protected spot, the cane was ground and the juice examined. In the case of full grown cane both Brix and polarization were ascertained and therefore the *available sugar* was calculated. In the cuttings field the canes are frequently so short that a plant gives too little juice to allow its being spindled. We then contented ourselves with polarization.

I believe that we can at the least count on a mean increase of 10 per cent. in the production of sugar cane fields following on a three or four-fold selection, and subseqent increase without selection, whilst the extra cost is very small owing to the above-mentioned simplifications.

In spite of all this, chemical selection is only employed to a limited extent in the Java sugar factories. The reason of this lies in the fact that within the last few years the sugar cane varieties reared by us from crossed seed have given distinctly larger yields. Since our experiment station is at present supplying the factories every year with about two million kg. of valuable cuttings derived from varieties of four years' cultivation, these attain the object in view much more speedily; and it is owing to that that the mean production of all the Java factories rose from 7,500 kg. of sugar in 1896 to 10,000 kg. of sugar per hectare in 1904 and 1905.

The individual plants of this new variety, which have not had much time to vary, show far fewer differences in their composition than do the old common varieties; but we have succeeded in establishing the fact that even in the case of these varieties a selection is possible, as *e.g.*, with a four-year old specimen an improvement of 4 to 8 per cent. was obtained within two years.

Another plot of varieties reared from seed is still under investigation so that we may have evolved a good method, when the factories succeed in finding from the new lots varieties most suited to their needs, since the latter are in general pretty sensitive to differences in soil and climate.

We have ourselves employed chemical selection for some years past in the choice of the parents used in our cross-fertilization experiments. As is known, blossoming of the sugar cane occurs very sparingly with many varieties, in some cases not at all. Owing to this limited blossoming it is extremely difficult to work with single plants; consequently we planted the varieties, which we proposed to cross, promiscuously, and left the wind to accomplish the pollination when panicles showed themselves at all. There are now comparative experiments in progress where in one case all the parents are rich in sugar, in other cases all of them have proved poor. Since in 1905 an exceptional amount of seed was reaped, about 3,000 seedlings of each group were obtained which will show this July to what extent chemical selection can further serve us.

It is therefore evident that through chemical selection sugar cane cultures are considerably benefited, and are placed in a better position to compete.

If through this competition we may possibly cause some damage to European agriculture, yet I believe that from these experiments very weighty consequences will result for other European cultural growths.

As far as I know, till now the chemical selection of vegetatively-increased plants has not been successful; for example, not in the case of potatoes, on which exhaustive experiments have been carried out. By analogy with our results, they would most probably succeed if one based one's selection, not as hitherto according to the starch percentage of *individual tubers*, but according to that of the *collective tubers of a plant*, and then employed the tubers of the richest plants for further planting experiments.

We are encouraged to take this view because von Seelhorst has already succeeded in demonstrating that in the case of potatoes a high weight of the collective tubers of a plant is an inherent property, just as we found to be the case with sugar canes.

Although tropical husbandry must frequently seek its own path, because laws which hold good for European conditions do not always apply there, it has yet as a whole much to be thankful for in the scientific researches of European experts. I should therefore be glad if the methods of selection evolved by us for the sugar cane should on their part prove of value to European agriculture.

The results arrived at by our experiments are laid down in the following conclusions:—

1. Different stalks of the same sugar cane plant vary widely in sugar percentage, even when they are of the same age. Consequently we founded the chemical selection on the analysis of the juice of the whole plant, not on that of single cane stalks.

2. The variability in sugar percentage of various sugar cane varieties is very different. Those grown from cane seeds do not vary so much as the old varieties.

3. The juice of the heavier plants is richer in sugar than of the lighter ones, and those plants that have the richest juice are the heaviest.

4. Plants grown from cuttings derived from canes rich in sugar are heavier and contain more sugar than those grown from average plants or from plants poor in sugar.

5. When we select the richest canes from the descendants of canes that were already rich in sugar, and also the poorest canes from the descendants of poor canes, and go on in this way for some years, we very soon arrive at a considerable improvement of the rich canes

(40% in five years) and a heavy depression in the descendants of the poor ones (60% in five years).

6. The descendants grown from cuttings of once selected canes remain richer in sugar for at least four generations, and show as an average of 40 experiments only a very small decrease.

7. The correlation of a high sugar percentage in the juice and a heavy weight of the cane plant simplifies the method of selection in a remarkable way. It is sufficient to select those 20% that are the heaviest, *i.e.*, the strongest tillered plants of the canefield, and plant the cuttings of one-half of these, viz., of those richest in sugar.

8. We proved that differences in the juice of the descendants of rich and poor canes are already visible at an age of 30 weeks and that it is possible to perform the selection at that age in the fields we use in Java for the propagation of cane cuttings. Highly selected canes of 20 weeks did not show any difference in the juice of the rich and the poor plots.

9. It is very probable that the same method of chemical selection that proved such a success with the sugar cane will give similar results with potatoes, if this selection will be founded on the starch percentage of all the tubers of a potato plant, and not on that of single tubers, as was done in former experiments.

J. D. Kobus.

SIMPLE METHODS OF CHEMICAL CONTROL.

By T. H. P. Heriot, F.C.S.

(Continued from page 293).

XII.

The Control of the Sugars.

Closely connected with the subject of the last chapter is the quality of the factory exports, so that it will be convenient to consider these before entering upon the intermediate stages of manufacture.

In the case of *grocery sugars*, where appearance is the first consideration, chemical analysis does not help us much. Colour may, of course, be roughly measured as in the case of the "Dutch standards"; or equal weights of the sample and of the standard may be dissolved in equal volumes of water and the resulting solutions compared as regards depth of colour, turbidity, &c. Apart from colour, the sparkling appearance of high-grade crystals is due to the *regular shape* of the individual crystals, and can only be secured by careful handling of the syrup and masse-cuite in the pan. With a view to maintaining this department of the factory at its maximum efficiency it is a good plan to compare samples of crystals cured from each strike of masse-cuite, so that the pan-boiler may be promptly called to account for inferior work.

Raw sugar, on the other hand, is sold on a basis of the polariscope test, which also serves for fixing the duty. Although the manufacturer usually sells his sugar through an agent who employs his own chemist, it is frequently desirable to know the polarization of the sugar as it leaves the factory. Or, it may be that the manufacturer is called upon to supply crystals of a given polarization.

The analysis of sugar is therefore of interest to the practical man, whilst to the chemist it shows how much of the indicated sugar in the juice is recovered in marketable form. By bringing the polariscope to bear on the exports as well as on the imports our calculated percentages (see Record C in last chapter) have a much more definite meaning than when only the weight of imports is recorded. Thus, 100 tons of refining sugar polarizing 96·0 is made up of 96 tons of pure sucrose contaminated with four tons of other substances (mainly moisture, glucose, and traces of mineral matter or ash). To convert tons of commercial sugar to tons of pure sucrose it is therefore merely necessary to multiply by the polarization and divide by 100. As it is still the general practice to express the percentage on the indicated in terms of commercial sugars, both statements are included in Record C.

SAMPLING AND ANALYSIS OF SUGARS.

To secure a single sample representative of the day's output it is sufficient for the sugar weigher to abstract a small measureful of sugar from each bag he fills, emptying the measure into a small dry keg or other receptacle. At the end of the day the contents of the keg are emptied out, thoroughly mixed and a measureful removed to serve as a laboratory sample. If there is no time to test the sugar every day, a weekly sample may be collected by storing one measureful, taken from each of the above daily samples, in a closed vessel, from which a final sub-sample is removed for analysis.

The German silver basin having been accurately counterpoised on the balance, the "normal polariscope weight" (26·048 grams.) is added to the right-hand pan, and the basin is half filled with the sample of sugar added by means of the bone spatula. The balance is "tried," and some sugar added or removed as may be necessary. This is continued until the addition or removal of a single grain of sugar leaves the balance in equilibrium. If the grains are large, one or two may be crushed to a powder in order to make the final adjustment exact.

The weighed quantity of sugar is next dissolved by following the instructions given in Chapter IV.; 2 cc. of basic acetate of lead being added to the measure flask before the contents are diluted to the 100 cc. mark. The solution, after being thoroughly mixed and filtered, is polarized in the same manner as the juice, but in this case the scale-reading of the polariscope gives the percentage of sucrose without any calculation.

XIII.

DETECTION OF AVOIDABLE LOSSES.

The factory chemist is usually called upon to account for the whole of the indicated sugar entering the factory, and to do this he must not only analyse every product into which the juice is worked up, but must also have facilities for weighing or measuring large masses of these products.

As this work is beset with technical difficulties and occupies much time, we shall here substitute some simple tests which can be carried out by those who have other duties to attend to.

The loss of sugar in the megass (which is only partially avoidable) having been already dealt with, we may pass to :—

(*a*) *The Loss of Sugar in the Filter-press Cake.*

With modern presses, the loss of sugar as juice is left in the cakes should not exceed 4% on the indicated; the cake itself containing from 7 to 10% of sugar. A sample is secured by breaking off a small fragment from several cakes and crushing these to a coarse powder in the wedgewood mortar. Fifty grams. of this powder is weighed into the metal basin, transferred to the empty and clean mortar, and rubbed up with sufficient water to form a cream. The latter is then poured through a funnel resting in the neck of a 200/220 c.c. measure flask. The residue in the mortar and that adhering to the pestle is rinsed into the flask with small additions of water, 10 c.c. of basic acetate of lead added, and the contents of the flask diluted exactly to the lower (200 c.c.) mark. The flask is shaken vigorously and emptied into a hydrometer immersion jar, where the mixing can be completed by closing the mouth of the jar with the palm of the hand, and inverting the jar several times. The mixture is then filtered and the filtrate polarized; the reading of the scale giving the percentage of sugar in the sample examined. It will be noted that in this case the 50 grams. of sample have been diluted to 200 c.c. (or 25 grams. to 100 c.c.) instead of the normal weight of 26·048 per 100 c.c. This is done to avoid a correction for the volume occupied in the flask by the insoluble matter, of which the sample contains about 40%.

A knowledge of the sugar content of the cake is not of much interest unless it is desired to calculate the loss of sugar from the gross weight of cakes discharged from the factory. If the cakes are firm and fairly brittle an analysis is generally superfluous, so that it is well only to test samples when the work appears to be at fault.

(*b*) *Loss of Sugar due to Defective Pan-boiling.*

In order that the crystals produced in the pan may be subsequently freed from impurities (molasses), the pan-boiler is obliged to leave a certain amount of sugar in solution, which is recovered on reboiling the separated molasses and recrystallizing the resulting masse-cuite.

As this course unavoidably leads to differences in quality and sale prices of the successive grades of crystals thus obtained, the importance of securing as large a proportion as possible of the superior grades is sufficiently obvious. A loss of first product, even though recovered in the form of second and third products, is clearly a loss in value, and is due to two defects in the pan work:—

1. Incomplete boiling, whereby too much sugar is retained in solution in the fluid portion of the masse-cuite.

2. Irregular boiling, resulting in the formation of crystals of various sizes, and loss of the smaller crystals which are carried through the centrifugal limes by the molasses.

In the case of low grade masse-cuites, boiled "smooth," a serious loss may occur if the curing operation be commenced before crystallization is complete.

In order to detect this loss of first product we propose to ascertain what percentage by weight of cured sugar is obtained from each strike of syrup masse-cuite discharged from the pan. It being impracticable to weigh and cure each strike of masse-cuite separately, we must work on an experimental scale, as follows:—

Masse-cuite Test.—The weight of masse-cuite to be tested is determined by the size of the centrifugal baskets in use, the object of the test being to cure a weighed quantity of masse-cuite under ordinary working conditions. A basket, 30 in. in diameter (the most general size), has a working capacity of 3 cubic feet, and the capacities of other sizes of baskets are usually stated in the makers' catalogue. As 3 cubic feet of masse-cuite weigh about 250 lbs., the charge is more easily handled if divided into three portions of a cubic foot each. Three stout wooden boxes, each provided with two pairs of handles (see Chapter II.), serve for conveying the masse-cuite from below the pan to the sugar-scale, and thence to the centrifugals.

As the masse-cuite flows from the pan, small portions of the strike are caught on a spade and transferred to the boxes, the latter being filled in turn. The sampling should not be hurried, but so timed that the first box is full when about one-third of the strike has been discharged, the other boxes being filled at the same rate. In this manner it is easy to collect three cubic feet of masse-cuite which will accurately represent the bulk of the strike, even though the contents of the pan were not uniformly mixed.

The filled boxes are piled, one above the other, upon the platform of the sugar scale, and the gross weight accurately noted. The contents of the boxes are then emptied into a single centrifugal basket, and re-weighed to find the tare. The experimental charge is then cured without the use of water or steam, which would dissolve a certain quantity of crystals. It is better to spin the basket for a longer time, say ten minutes, and always to carry out the experiment under the same conditions and with the same basket. A small sample of the molasses, caught direct from the outlet of the centrifugal, should be reserved for a future test (see below). The cured sugar is finally discharged upon a tared tray and weighed. We give an example:—

$$\frac{\text{Net weight of cured sugar} = 171 \text{ pounds.}}{\text{,, \quad ,, \quad masse-cuite} = 260 \text{ pounds.}} \times 100 = 65{\cdot}8\%.$$

This may be taken as a fair average result, but as the percentage fluctuates considerably with the varying purity of the juice, an additional check is desirable.

Recollecting that *purity* merely expresses the ratio between the sucrose and total solid matters, it is obvious that the purity of the juice is not effected by evaporation of the contained water, and, consequently, that the purity of the masse-cuite is approximately the same as that of the juice from which it has been made. By ascertaining the purity of the masse-cuite we are therefore able to decide whether the experimental yield obtained as above is good, bad, or indifferent. In the example given, the purity of the masse-cuite was 88·0, but we must explain how this is ascertained.

Before weighing the three boxes, a few ounces of masse-cuite are removed from each and thoroughly mixed. About three ounces of this mixed sample (actual weighing is not necessary) are placed in a wide-mouth stoppered bottle,* and as much rain-water added as will fill one of the jars used for testing densities. The bottle is then vigorously shaken at intervals until every trace of masse-cuite is dissolved, when the density of the solution is observed by means of the Brix hydrometer. If the density, corrected for temperature, falls within the limits, 15·0–20·0, the degree of dilution is sufficient. If above 20·0 a little water must be added; or if below 15 a little more masse-cuite must be dissolved in the original liquid. Having thus prepared a solution of masse-cuite of approximately the same density as the original juice, the solution is to be analysed in precisely the same way as the juice; the purity being then calculated from the density and per cent. by weight of sucrose (see Chapter X., p. 191).

The masse-cuite test can only be applied to low grade masse-cuites when these have been crystallized in motion; In the usual form of crystallizing tank a partial separation of sugar takes place so that it is practically impossible to secure a representative sample of the mixture.

In order, then, to control the later stages of the pan work we must examine the final molasses, and satisfy ourselves that it contains the minimum of dissolved sugar. If the first and final stages of the boiling pass muster, the yield obtained in the intermediate stage or stages will have been satisfactory.

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* One of those used for preserving samples of juice.

Now, it is hardly necessary to state that the final molasses contain at least 30 per cent. of sugar which could be crystallized if the accompanying impurities were separated. No economic method of doing this having yet come to light, this residual sugar is generally converted into alcohol, and thus recovered in another form, or the molasses are sold for a mere song. In factories not equipped with a distillery it becomes of vital importance to extract as much sugar as possible from the molasses.

How much sugar the final molasses ought to contain largely depends on the purity of the juice, or, more correctly, on the nature of the impurities present, some of which tend to keep the sugar from crystallizing, and are therefore known as *molasses-formers*. But, instead of examining the impurities, which would entail rather intricate methods of analysis, we can arrive at the desired information by means of an experiment which requires a word or two of explanation.

If the syrup masse-cuite is cured hot (the most general practice) the molasses escaping from the centrifugal will be a super-saturated solution of sugar; that is, a solution from which sugar will crystallize out on cooling. Even whilst still warm, such molasses invariably contain a large quantity of crystals which are too small to be retained by the liners of the centrifugals. Rubbed between the finger and thumb, such *first* molasses are felt to be granular, whereas *true* or *final* molasses are perfectly smooth to the touch. The said crystals re-dissolve during the re-boiling of first molasses, and re-appear on cooling as second or third sugars. Consequently, if what is called *first* molasses could be completely deprived of crystals, the remaining fluid would be *true* molasses, containing the minimum quantity of dissolved sugar. We propose to remove these crystals by filtering the *cold* molasses through a strainer of a much finer texture than that employed for the centrifugal liners.

Molasses Test.—This is carried out on the sample of molasses reserved from the *masse-cuite test*, but time and labour can be economised by mixing together many samples of molasses, and carrying out the test at the end of each week.

Assuming that every strike of syrup-masse-cuite is tested as directed above it will be sufficient to reserve one test-tubeful of molasses from each experiment, storing these together in a tin canister capable of holding about two pints, and provided with a lid. The contents of the canister must be thoroughly mixed every time a sample of molasses is added, as stirring promotes crystallization. At the end of the week the canister will be more or less filled with *cold* molasses, but in order to allow time for the later additions to become fully crystallized, the next operation of filtration may be delayed until the following week. Even with this delay the result will be obtained many days in advance of the slow operations in the factory where the same molasses are being boiled and re-boiled at long intervals.

The filter is made of closely woven brass wire, having 100 meshes to the lineal inch. A square piece, measuring 12 inches on each side is folded and re-folded in exactly the same manner as a filter paper* but making only four folds in all. The four corners of the square, which now project from the broad end of the folded gauze (see *Fig. 11.* Chapter IV.) may be cut away with a pair of shears, so that the piece of gauze is rendered circular in form when opened out flat. In doing this, the folds must not, of course, be obliterated; but, by careful handling, the gauze filter is given a form similar to that shown in *Fig. 12,* so that it can be inserted in a large glass funnel. To render the filter effective, every trace of grease is now removed from the gauze by immersing it in a strong solution of caustic soda, and then in several changes of clean water. Whilst still quite wet the filter is placed in the funnel, the latter being supported in the wooden ring of the filter stand instead of the arrangement shown in *Fig 13.*

The week's sample of molasses is now transferred to the filter-gauze until the latter is quite full. A small cylinder is placed under the funnel, to catch the filtered molasses, and the funnel covered with a ground-glass plate.

In spite of the fine gauze-mesh, the first portion of the filtrate contains many minute crystals which can be seen on spreading a drop or two upon a clean piece of glass and holding this in front of a strong light. The appearance will be much the same as that of syrup at the "graining point." By rejecting the first ounce of filtrate, that which follows will be free from crystals and, therefore, true molasses.

This is collected in a 100-110 cc. measure flash, which has been previously allowed to drain dry and accurately weighed. The support holding the funnel should be raised or lowered so as to cause the stem of the funnel to just enter the neck of the flask (if the former be not too wide).

Thus arranged, the apparatus must be left to itself for several hours; in fact, a whole day may sometimes elapse before sufficient material is collected for analysis; namely, the half-normal weight (13·024 grams.); a single weight of this value being furnished with the polariscope. This is added to the tare of the empty flask on the right-hand pan of the balance, and as soon as the flask contains sufficient molasses to turn the scale, a small quantity of the latter may be removed by means of a glass rod until an exact equilibrium is secured. If too much molasses is thus removed it is merely necessary to touch the interior of the neck of the flask with the moist rod in order to return a fraction of the material removed. The adjustment must be continued until the index-pointer of the balance remains stationary at the zero line, or swings to equal distances on either side.

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* See Instructions, in Chapter IV., p. 465.

Some hot rain-water (previously heated in a test tube) is added to the flask, and the latter gently shaken from side to side until the molasses are dissolved. The solution must then be thoroughly cooled by immersing the body of the flask in cold water and gently shaking. 10 cc. of lead solution are run in from a pipette and, finally, as much water as will dilute the whole exactly to the lower mark (100 cc.). After mixing, the solution is filtered and polarized as in the analysis of juice and sugar. The mean of 5 readings multiplied by 2 gives the percentage of sucrose.

The final molasses obtained in the factory can also be sampled daily, and analysed once a week. It is rarely quite free from crystals, but these should not be removed by filtration as they constitute part of the actual loss of sugar to be detected. As there is plenty of this material for analysis, it is weighed into the counterpoised metal basin, and dissolved therein by stirring with cold water; the half-normal weight being taken as before, and the same volume of lead solution. This simple method of analysis is not very accurate in the case of such impure material as molasses, but provided that the test is applied in both cases under exactly the same conditions, the figures obtained will be strictly comparative, and therefore of practical value.

In comparing the sugar content of the molasses prepared in the laboratory with that of the final molasses obtained in the factory, a close agreement must not be expected although the differences should not be great. The liming of molasses before or during re-boiling has some effect on the subsequent crystallization, and it is also necessary to compare molasses of the same origin (*i.e.*, derived from the same first molasses). By averaging the analytical results obtained during the whole crop season, a much more satisfactory conclusion can be arrived at.

(c) *Losses of sugar during curing.*

These are mainly due to the excessive use of water (or steam) for purging the sugar, and can only be partially avoided in the manufacture of white crystals. A few experiments should be made in which baskets charged with the same masse-cuite are spun for a given time with diminishing quantities of purging water (or shorter applications of steam), and the resulting sugars polarized and their colours compared. In the case of refining crystals, the use of water or steam in the centrifugals should be dispensed with entirely.

(To be continued.)

THE CONTEST BETWEEN BEET AND CANE SUGAR.*

By Sigmund Stein, Liverpool.

(Continued from page 298.)

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2. Cane Sugar.

In the sugar family cane sugar is the elder brother and should have been mentioned first. As however it has been the more modest of the two in regard to progress and has kept for a long time silent and only recently adopted the scientific principles of its younger rival, we have given it the second place in our consideration. If we find in the beet sugar industry only the most scientific and the most modern factories in existence, we find still extant in the cane sugar industry the older methods known many hundreds of years ago. We find the most primitive methods in the East Indies but we must give great credit to the wonderful installations in Java, Cuba and Hawaiian Islands. We have to record in this industry very small yields in India, but astonishing yields in the Hawaiian Islands. What ingenuity, hard work and science have done of late years for the Continental beet sugar industry to bring it to the position it holds to-day, the wonderful power of nature and the tropical sun has likewise performed for the sugar cane for many centuries past. I shall deal in my paper with only the principal cane sugar countries. It would be impossible for me to refer in this general paper to the many small territories that grow cane, as its scope is strictly limited by our careful committee, but you can easily draw your own conclusions when you describe the life of a rich man and then say that similar considerations rule in the case of his less fortunate neighbour. Let us commence with

(*a*) Java.

I mention this country first as in the cane sugar world Java takes the foremost place. We find here scientific cultivation of cane united with scientific manufacture of cane sugar and properly equipped sugar factories. From very small beginnings this industry has increased until now Java produces nearly a million tons of cane sugar. It was by the aid of the Dutch Government that this industry was brought to its present high state, and sugar forms the principal product of manufacture and export in that island. Its dense population is mostly interested in the cane cultivation and to such an extent that very little land remains for the people to cultivate for themselves other products for their maintenance. The area of cultivation cannot be extended ad libitum as only certain parts of the island are suitable for cane growing. The high state of scientific cultivation has raised the yield of cane per acre to about 40 tons; the yield of sugar is, however, between 10% and 11%. There are only a few factories which are owned by the Chinese, and these are worked in the old antiquated style. An important discussion took place some time ago regarding the cost of cultivation and the working of the sugar cane in Java. This is a question of great importance considering the considerable part Java has played and is playing in the supply of sugar to the world's sugar market. From all the inquiries I have made I conclude the cost of producing sugar there is about 9s. per cwt. free on board. Considering this is the price in one of the most important and progressive of the cane sugar countries, it gives us a fair criterion for contrasting the working of cane sugar factories with Continental beet sugar factories. Most of the Java sugar goes at present to China and Japan and a certain quantity to the U.S.A. Last year an appreciable quantity was shipped to the United Kingdom.

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* **Read at the International Congress of Applied Chemistry, Rome, 1906.**

From latest information we learn that the manufacturers in Java are looking forward to a very bad time on account of the great difficulty of finding the necessary capital which such an industry and such an agriculture requires.

(*b*) QUEENSLAND.

Here we find the chief difficulties lie in the climatic conditions and the exhaustion of the soil. Plant diseases and pests trouble the planters very much. The labour question also plays an important part. By the law of the country, from the year 1906 the importation of coloured labour once employed on a very large scale is forbidden. What this means, you can easily imagine. The cultivation of the cane is not very much up to date but hopes are expressed that this will improve. The crop does not cover the consumption of the Australian Continent, at least 60,000 tons of sugar have to be imported. As the *Mackay Mercury* predicts, a very bad time is coming for the Queensland sugar industry on account of the stoppage of coloured labour.

(*c*) HAWAIIAN ISLANDS.

The industry in these islands exists beneath the protective sway of the American Government. Here we see splendidly equipped factories with the newest machinery and appliances, scientific management, scientific agriculture and yields of sugar per acre never before heard of in any other sugar country of the world. American and English capital has found its way here since these islands had the good fortune to come under the rule of the stars and stripes. A great amount of money was expended lavishly just to show to the sugar world how much sugar could be produced, irrespective of what it cost; cost what it may the high percentage of sugar must be shown. This, however, is not business. Very costly irrigation systems have been installed, the steam plough works everywhere and very deep ploughing not known in any other country is the rule. If, however, we look behind the scenes we find that all this expenditure for the items mentioned is so enormous, that the cost of producing this vast quantity of sugar per acre is higher than in any other country. From information I have received, sugar could not be produced cheaper than 8s. 6d. per cwt. in the factory in this country, not counting the heavy expenditure to send this sugar to the ports of the U.S.A. As long as Hawaiian sugar can come duty free to the U.S.A. Hawaii has a great pull. What will it be when the time arrives when the U.S.A. market is more than stocked by their own production and more American sugar is available than the people of the U.S.A. can consume? There will be a fight and a stagnation and then we shall see who are the fittest and who are the survivors. We must not forget here the labour question. The natives are not fitted for heavy work. The Chinese who used to work very well have been excluded by law and now the Hawaiian planters try to import coolies from India and likewise Portuguese from Madeira and Azores; further, labour has been imported from Spain, Italy, Norway, Corea, Japan and Russia. It is the labour question again and again which troubles the planter. Hawaii produces about 370,000 tons of sugar.

(*d*) MAURITIUS.

This Island produces at present 200,000 tons of sugar. Heavy manuring brings large yields of cane. The process of manufacture on this island varies very much. We find the most primitive and old fashioned factories along with the more modern ones and those well equipped and up to date. The labour question is better here as they have imported coolies from India the last few years, and therefore the manufacturer works more cheaply. The great drawbacks in this island are the periodical cyclones which visit the place and occasionally bring great distress to the land. The sugar produced is sent mostly to East India and South Africa.

(*e*) CUBA.

For many years Cuba was, and still is, the place at which the whole world's sugar market looked with a suspicious eye. Cuba was for a long time the greatest sugar producer in the whole world, and she at present still produces over 1,000,000 tons per annum. We find here that for half a year rains prevail in the island and provide good conditions for vegetation. The soil is very fertile, frosts are unknown but still only a small part of the island is cultivated with cane, and it is an open question whether the cane cultivation will be extended. We have all read reports in the papers about Cuba, saying that she may produce three to four million tons of sugar, flood the world's sugar market with it and bring great distress to all. According to my information and to the investigations which I made about Cuba when I was in America last year, I am sure that it is impossible to enlarge the cane cultivation to any great extent. Not all the land of the island is suitable for cane growing, and a great part of the soil has already been exhausted, and only by heavy manuring can it be brought to a certain degree of fertility which is necessary for the successful cultivation of the cane plant. The well known difficulties in transport must not be forgotten. As just mentioned the climatic conditions of this island are peculiar. We find the period of rains is from April to June, and from these rains the cane suffers very much. The sugar contents are lessened and a great quantity of invert sugar is formed. The planters, therefore, try to finish the campaign as soon as possible to prevent any loss. We find here well-equipped factories with the newest machinery and working under scientific management. We also find old models working in the old fashioned way. It is very difficult to speak about the cost of production in this island, but in any case it cannot be very small when one considers the very heavy wages paid for labour. The negro population who were once slaves are now freed men and demand high wages. Other industries existing in the island, such as tobacco plantations and mines, do not cheapen the cost of labour. The almighty dollar easily finds its way here, and a 20% reduction on the import duty of Cuban sugar into the U.S.A. was accorded in December, 1903; this has helped the industry very much and causes nearly all the sugar to go to the States. How will it be if the U.S.A. possessions extend their production so far that it exceeds the consumption? How will Cuba fare then? In what relation will she stand to the other sugar producing countries of the world? We shall see then by the survival of the fittest which is the superior. If Cuba receives in time to come more concessions from the United States or perhaps is allowed to import duty free into that country, she may then enlarge the area of her sugar cultivation.

(*f*) LOUISIANA.

This territory is entirely dependent on the state and changes of climate, and the great enemy of the Louisiana planter is the frost. His great friend is the Mississippi; the latter's fertile valleys are the great tracts for the cultivation of good cane and the production of good sugar. But old planters have complained to me about their difficulties regarding labour. The times have passed when each planter had his hundreds of slaves. The State destroyed the prosperity of the planter by the abolition of slavery. But it helped them by the protective tariff, and so we now see Louisiana producing 300,000 tons of sugar. The cane, however, is not very rich because the time of its vegetation is only very short. We see in Louisiana well equipped factories under very good and scientific management but we also see old plantations producing only syrup. I myself inquired on the spot into the cost of production of sugar there, and I may say that the cost in Louisiana is still very high and cannot compete with European beet. Everything depends on how long the U.S.A. will keep her protective hand over the home sugar industry.

(*g*) PORTO RICO.

Another of the protected children of the U.S.A. I mention this island specially in spite of its only producing 210,000 tons of sugar, because being a U.S.A. possession, its sugar goes duty free into the States. It has been suggested on many occasions that this island like Cuba would extend her sugar production many times, but after making inquiries myself I must be allowed to dispute this. There is much to the credit of this island, cheap labour, good factories installed by American capital, fertile soil, and a good climate. The cost of producing sugar as published in American summaries, shows that it is no lower than in the principal beet districts of Europe. The mountainous conditions of the island prevent the extension of cane culture to any great extent.

I have mentioned here only the most important cane countries which will play an important part in the coming sugar contest. The scope of this paper forbids me to go further and mention other still important cane countries.

From very small beginnings the world's sugar industry has risen to its present gigantic dimensions. From one million tons 60 years ago, we produce now 13,000,000 tons of sugar.

The fight existing now in the different sugar producing countries between cane or beet consists in each taking advantage of the consumption to distribute the production at the best possible prices. For many years the cane sugar industry was under a great disadvantage. Continental beet countries allowed to the sugar producer bounties, doles and presents on the exportation of their sugars.

By the Brussels Convention, however, beet and cane have been put on the same level in the world's sugar market, which is now free to both of them. The beet sugar industry with its regular scientific cultivation and manufacture has a permanent opponent in the cane sugar industry with its manifold processes of manufacture and varieties of products. In the scientific making of cane sugar many processes have been adopted by these manufacturers which were invented by the ingenuity of the beet sugar manufacturer. Friendship should exist between master and pupil. We very often are told that the cost of producing a cwt. of cane sugar is very much lower than that of producing a cwt. of beet sugar. Thus I was informed not long ago by one of the principal and best versed men in the sugar industry in England that beet can never compete with cane. But I have laid facts before you from which you may derive your own conclusions and judge for yourselves.

The price of sugar on the world's sugar market is not determined by the very low cost of production of one single country which with favourable conditions of climate, labour, &c., produces sugar cheaply. The price, however, is regulated by the cost of production in those sugar producing countries which are not so favourably situated but whose production is necessary and needed to cover the world's demand in sugar. How does it stand therefore in years of a sugar crisis? If the supply exceeds the demand and the market is over-burdened with sugar the prices must fall. In this crisis only the fittest can survive and only those sugar producing countries who can sell the cheapest can dictate the prices to the world's sugar market. In such a crisis the weakest must fall, and they must stop their sugar production or at least greatly limit it. In an equal fight with equal weapons cane sugar and beet sugar will each have the same facilities and drawbacks. We are all depending upon the consumption, and the consumption is increasing. Beet and cane are on the world's sugar market placed side by side, no superiority is given to one or the other, there is room for both and there is no time for jealous attacks or complaints.

It is not the quantity of sugar which is *produced* which counts for the sugar manufacturers, but it is the quantity which is *consumed*. It would not be necessary to limit the area of cane and beet cultivation if we can increase our consumption. How can the sugar consumption be increased? The answer is, let all the countries consume more than they do at present. We have not yet arrived at the point where the sugar consumption in different countries has reached that of the 36·90 kilograms, equal to 81·3 lbs. per head of population per annum in England, of that of U.S.A. of 31·95 kilograms equal to 70·4 lbs. per head of population per annum (1905). The average sugar consumption of the civilized world per head of population per annum is only 15·84 kilograms, equal to 34·9 lbs. Here you see is great room for improvement, and we have all to eat more sugar. Less sugar is consumed if the price is too high.

It is not the world's market prices alone which dictate the selling prices of sugar to the consumer, but to a great extent also the sugar duties and the sugar taxes which burden the consumer. These taxes have been reduced lately in different countries but not quite enough. They should be reduced to such a level that the sugar consumer will find this great article of food and diet very much cheaper. Sugar taxes being only for the benefit of the Exchequer, the latter will naturally resist, because it must have some revenue and every reduction of taxes lessens its income. Do the different finance ministers realize that if the taxes were reduced by one half and the sugar consumption doubled, that their revenues would be the same? Yet why tax sugar at all? Why do we not also tax bread and potatoes? Is not sugar quite an indispensable article of diet, and can we not by the abolition of sugar taxes bring this article nearer to the masses, and giving up the idea that, sugar is a luxury, come instead to the conclusion that it is a necessity? Away with the sugar taxes! and we shall have the world's sugar production and consumption balanced to the benefit of industry, agriculture and mankind in general.

THE COMPOSITION OF THE SUGAR CANE AND ITS PRODUCTS IN LOUISIANA.*

By Dr. Charles A. Browne, Jun., New Orleans.

(Continued from page 316.)

Clarification and Evaporation of Cane Juice.

In the clarification of sugar cane juice in Louisiana a number of processes are in use, but some form of sulphitation is the course most generally followed. The juice is treated first with sulphur dioxide until it shows an acidity of about 5 cc. decinormal to 10 cc. of juice. The liquid is then brought back with lime to neutrality or faint acidity, and then heated until the blanket of impurities, which forms on the surface, begins to break. The juice is then usually skimmed and the suspended impurities allowed to deposit, this being accomplished either directly in the clarifiers or in settling tanks and automatic subsiders. Superheaters and filter bags are frequently used in connection with this method of clarification to facilitate the subsidence and elimination of impurities.

Carbonatation is practised in only one sugar house in Louisiana, the average high content of the juices in reducing sugars and the consequent danger from over-liming having discouraged the introduction of this process. Among other clarifying agents, phosphoric acid and acid phosphate of lime should be mentioned, these being used either directly with lime or as an adjunct in the process of sulphitation. On a few plantations lime is the only agent used for clarification, and in some cases, where syrup making is the main object, simple boiling and skimming are the only means practised for the coagulation and removal of impurities.

In the early history of the sugar industry in Louisiana, the evaporation and boiling of sugar cane juices were conducted entirely in open kettles, and there are at present about sixty small sugar houses in the State employing this process. These open-kettle houses obtain a comparatively low yield of sugar from the cane, but manufacture a very superior grade of syrup and molasses. A partial caramelization of the sugars gives all open-kettle products a particularly agreeable flavour, and the relatively high market price, which such syrups and molasses command, is the only factor which warrants the continuance of this primitive method of sugar manufacture.

Of the other two hundred sugar houses in Louisiana, all employ some form of vacuum apparatus, and, by visiting different plantations, it is possible to trace the entire development of multiple evaporation from the old original evaporator of Rillieux to the latest improved type of quadruple effect.

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* Read at the International Congress for Applied Chemistry, Rome, 1906.

The methods of boiling and the working up of the molasses into lower products in Louisiana require perhaps a few words of comment. The use of crystallizers is very limited, the separation of sugar from the molasses being accomplished almost entirely by allowing the masse-cuite to stand for varying periods of time according to the purity of the product. In case of second sugars the masse-cuite is allowed to remain in cars in the hot room for two to four weeks; for the third sugars the final masse-cuite is left in cars or tanks for six to eight months. With good working, the yield of commercial sugars,—Firsts, Seconds, and Thirds,—should equal the weight of sucrose in the juice. Exhaustion of the molasses is attained when the sucrose percentage is reduced to that of the reducing sugars.

It can readily be seen that with the great differences in the juices, and the large diversity in processes of clarification and manufacture, wide variations must exist in Louisiana in the character and composition of the various sugar house products. In the brief space at our command we are unable to enter into a complete discussion of these differences, and must therefore limit ourselves to a few typical instances.

YIELD AND COMPOSITION OF SUGAR HOUSE PRODUCTS.

The sugar season in Louisiana begins usually about the middle of October. At this period the juices are of relatively low sucrose content and inferior purity, and two boilings are usually sufficient to secure all the available sugar. Table IX. gives the yield and composition of the various products obtained with a low-grade juice. It should be stated, however, that these results and those of Tables X. and XI. are purely schematic, being made up from the average results of a great many sugar house and laboratory experiments.

All calculations were performed upon the basis of 1,000,000 pounds of cane and an extraction of 75 per cent. The composition of syrups, molasses, and masse-cuites were all made upon a percentage of total solids of 50, 80, and 90 respectively, these figures being the general average; individual instances, however, may show considerable variation from these percentages. In each of the tables a First sugar of 96% sucrose content was taken as the basis. The Louisiana sugar planter, for economic reasons, aims to secure the greatest possible yield of 96 test sugar, and he accomplishes this result very frequently by making a high-grade First of 98 test and then bringing this down to 96 by mixing in the requisite quantity of Seconds.

TABLE IX.

Yield and Composition of Sugar House Products from a poor Juice.

	Pounds.	Total Solids.	Sucrose.	Dextrose.	Levulose.	Ash.	Albuminoids.	Amids, &c.	Acids, Gums, &c.
Cane	1,000,000	—	—	—	—	—	—	—	—
Raw Juice	750,000	13·50	10·00	1·20	0·80	0·45	0·10	0·15	0·80
Sulphured Juice	750,000	13·30	10·00	1·20	0·80	0·40	0·02	0·15	0·73
Clarified Juice	750,000	13·20	10·00	1·20	0·80	0·45	0·03	0·15	0·57
Syrup	198,000	50·00	37·90	4·40	3·20	1·70	0·10	0·58	2·12
1st Masse-cuite	110,000	90·00	68·20	7·00	6·60	3·00	0·15	1·05	4·00
1st Sugar	48,000	98·75	96·00	0·80	0·70	0·80	0·01	0·04	0·40
1st Molasses	64,500	80·00	44·80	11·40	10·80	4·50	0·22	1·78	6·50
2nd Masse-cuite	57,330	90·00	50·40	12·50	12·50	5·00	0·23	1·97	7·40
2nd Sugar	20,000	94·00	80·00	3·90	4·10	3·00	0·06	0·64	2·30
2nd Molasses	41,000	80·00	31·40	15·00	16·00	5·60	0·30	2·40	9·30

TABLE X.

Yield and Composition of Sugar House Products from an average Juice.

	Pounds.	Total Solids.	Sucrose.	Dextrose.	Levulose.	Ash.	Albuminoids.	Amids, &c.	Acids, Gums, &c.
Cane	1,000,000	—	—	—	—	—	—	—	—
Raw Juice	750,000	15·00	12·00	1·00	0·70	0·45	0·10	0·10	0·65
Sulphured Juice	750,000	14·80	12·00	1·00	0·70	0·40	0·02	0·10	0·58
Clarified Juice	750,000	14·70	12·00	1·00	0·70	0·45	0·03	0·10	0·42
Syrup	220,588	50·00	40·80	3·20	2·58	1·50	0·09	0·33	1·50
1st Masse-cuite	122,550	90·00	73·44	5·70	4·70	2·70	0·13	0·63	2·70
1st Sugar	54,000	98·75	96·00	0·80	0·70	0·80	0·01	0·05	0·39
1st Molasses	71,213	80·00	53·60	8·76	8·00	4·00	0·20	0·94	4·50
2nd Masse-cuite	63,300	90·00	60·30	9·43	9·43	4·50	0·21	1·08	5·05
2nd Sugar	24,000	95·50	85·00	2·90	3·10	2·50	0·06	0·34	1·60
2nd Molasses	42,563	80·00	41·70	12·20	12·50	5·35	0·25	1·50	6·59
3rd Masse-cuite	37,883	90·00	46·90	13·30	14·50	6·00	0·26	1·70	7·34
3rd Sugar	30,000	94·00	80·00	3·80	4·20	3·50	0·07	0·43	2·00
3rd Molasses	30,750	80·00	31·70	15·00	16·50	6·30	0·30	2·00	8·20

TABLE XI.

Yield and Composition of Sugar House Products from a good Juice.

	Pounds.	Total Solids.	Sucrose.	Dextrose.	Levulose.	Ash.	Albuminoids.	Amids, &c.	Acids, Gums, &c.
Cane	1,000,000	—	—	—	—	—	—	—	—
Raw Juice	750,000	15·50	13·50	0·60	0·40	0·40	0·10	0·15	0·35
Sulphured Juice	750,000	15·35	13·50	0·60	0·40	0·38	0·02	0·15	0·30
Clarified Juice	750,000	15·30	13·50	0·60	0·40	0·42	0·03	0·15	0·20
Syrup	229,500	50·00	44·10	1·80	1·50	1·37	0·08	0·51	0·64
1st Masse-cuite	127,500	90·00	79·40	3·10	2·80	2·50	0·12	0·88	1·20
1st Sugar	72,000	98·75	96·00	0·80	0·70	0·80	0·02	0·13	0·30
1st Molasses	54,563	80·00	58·90	6·00	5·80	4·70	0·25	1·85	2·50
2nd Masse-cuite	48,500	90·00	66·20	6·65	6·65	5·30	0·26	2·10	2·84
2nd Sugar	25,000	96·50	90·00	1·40	1·60	2·50	0·05	0·40	0·55
2nd Molasses	24,269	80·00	39·70	11·40	12·00	8·00	0·40	3·50	5·00
3rd Masse-cuite	21,572	90·00	44·60	12·30	14·00	9·00	0·41	3·69	6·00
3rd Sugar	5,000	95·75	85·00	2·80	3·20	3·50	0·06	0·49	0·70
3rd Molasses	18,284	80·00	29·40	13·60	15·80	9·80	0·43	3·97	7·00

The results of Table IX. (two boilings) with a poor juice of low purity indicate a yield of 136 pounds (6·8%) commercial sugars, or 124 pounds (6·2%) pure sucrose and 82 pounds residual molasses (about 7 U.S. gallons) per ton of cane.

The results of Table X. (three boilings) with an average juice of 80 purity give a yield of 176 pounds (8·8%) commercial sugars, or 160 pounds (8%) pure sucrose and 61·5 pounds residual molasses (about 5 U.S. gallons) per ton of cane.

The results of Table XI. (three boilings) with a superior juice of nearly 90 purity show a yield of 204 pounds (10·2%) commercial sugars, or 192 pounds (9·6%) pure sucrose and 36·5 pounds residual molasses (about 3 U.S. gallons) per ton of cane.

In the process of boiling, and during the long standing of the lower products in the hot room, a series of interesting chemical changes take place, with the result that the non-sucrose constituents of the final molasses are entirely different in character from those of the original juice. In the brief space at our command we can allude to but a few of the chemical transformations produced.

It will be noted first of all in the three tables that a very marked difference exists in the relationship of dextrose and levulose between the raw juice and the final products, the dextrose being in excess in the former and the levulose in the latter. An excess of levulose in sugar cane molasses is also shown in analyses by Pellet, Stein, and other chemists. It must of course be remarked that our methods of estimating dextrose and levulose in such a complex medium as molasses fall considerably short of absolute perfection; nevertheless the results plainly indicate a greater preponderance in cane molasses of levorotatory substances, showing either a formation of new products of this character or a transformation of a part of the dextrose into reducing bodies which polarize less to the right. The latter alternative in the case of cane molasses is extremely probable, for it is a well-known fact that by the action of alkalies and many of their salts the various reducing sugars dextrose, mannose, and levulose are readily convertible, one into the other. Such a reaction is in fact very marked in a alkaline clarification of cane juice, as by carbonatation, and as a consequence the molasses from such juice, as Pellet has shown, contains reducing sugars which were not originally present, such as mannose and glucose.

The extreme sensitiveness of dextrose and levulose to molecular rearrangement in the presence of the merest trace of alkali may be nicely demonstrated by boiling a solution of either sugar in a glass flask for several hours. The alkali dissolved from the glass is sufficient to effect the transformation of a considerable amount of each sugar into the other homologue. Experiments upon the transmutation of sugars usually show a more rapid tendency upon the part of dextrose to pass into levulose than the reverse, and the excess of levulose in low-grade cane products may be satisfactorily explained upon this assumption.

Another series of chemical changes which takes place in cane products during the boiling and standing is observed in the ash. The sulphuring of cane juice causes a coagulation and precipitation of albuminoid matter, and with this precipitate a perceptible amount of mineral matter is carried down. On the addition of lime there is a further precipitate of insoluble sulphates and phosphates of calcium, but we have also the formation of considerable sulphite of lime, so that the percentage of ash in the clarified juice may be the same or even greater than before sulphuring. During the boiling and standing, however, the soluble sulphite of lime becomes oxidized to sulphate; this process of oxidation is usually complete within four to six weeks, the result being that a large amount of insoluble calcium sulphate is held back mechanically in the second and third sugars.

The composition of the ash of residual cane molasses from several factories in Louisiana is given in Table XII.:—

TABLE XII.

Composition of Ash from different Molasses.

	I. Mill Sulphitation.	II. Diffusion Sulphitation.	III. Open Kettle.	IV. Carbonatation.
Potash, K_2O	49·48	52·20	51·48	50·16
Soda, Na_2O	0·89	0·80	1·11	0·32
Lime, CaO	6·47	6·78	6·58	8·53
Magnesia, MgO	4·29	3·09	3·99	2·66
Iron Oxide, Fe_2O_3	0·35	0·33	0·15	0·47
Alumina, Al_2O_3	0·30	0·22	0·13	0·30
Silica, SiO_2	4·12	4·59	2·83	4·10
Phosphoric Acid, P_2O_5	3·71	3·80	2·12	0·91
Sulphuric Acid, SO_3	10·79	6·72	10·94	11·18
Carbonic Acid, CO_2	7·49	11·19	13·06	15·78
Chlorine, Cl	14·00	11·95	9·10	4·59
Total	101·89	101·67	101·49	99·00
Deduct O = Cl	3·16	2·70	2·05	1·04
	98·73	98·97	99·44	97·96
Undetermined (Carbon, &c.)	1·27	1·03	0·56	2·04
Alkalinity (cc. $\frac{n}{10}$ per grm. Ash)	80 cc.	93 cc.	95 cc.	109 cc.

Comparison of the above analyses with those of the ash of cane juices (Table VI.) shows several very striking differences. There is only about one-half the quantity of sulphuric acid in the molasses ash, notwithstanding the heavy sulphuring which some of the juices received. This of course is due to the removal of the sulphuric acid as calcium sulphate; the same also holds true of phosphoric acid. We note also an increase in the amount of lime in the molasses ash, with a corresponding increase in carbonic acid and alkalinity and a decrease in iron, alumina, and silica. The variations in chlorine content of the four ashes are especially noteworthy, and we have here a good illustration of the influence of local conditions upon the composition of cane products. Molasses I. was produced upon a plantation near the gulf where the cane fields are occasionally flooded with salt water; Molasses IV., on the other hand, was produced on a plantation in the interior of Louisiana, over a hundred miles from the coast. The excess of chlorides in lower-coast molasses, such as I., is frequently perceptible to the taste, and this of course injures its sale for household purposes.

The nitrogenous constituents of cane juice also undergo a number of very important changes during the process of manufacture. The sulphuring causes a coagulation of much of the albuminoid matter, but a small portion of this is reconverted into a soluble form by the action of lime and heat. The ratio of albuminoids to other nitrogenous constituents, which is about 1 : 5 in the clarified juice, increases during the process of manufacture and becomes about 1 : 8 or 9 in the final molasses. This indicates very clearly a breaking up of the soluble peptones or albumoses into amids and other nitrogenous bodies. These latter are also destroyed, especially during the boiling of the second molasses, a loss of 15 per cent. of the total nitrogen usually resulting at this stage of the process. This loss is probably due to the escape of ammonia with perhaps some gaseous nitrogen. The distribution of the nitrogen of residual cane molasses among the different bodies shows, as might be supposed, very noticeable differences from what exists in the raw juice.

TABLE XIII.

Distribution of Nitrogen in Sugar Cane Molasses.

	Percentage in Molasses.	Percentage of total Nitrogen.
Nitrogen in albumoses and peptones ..	0·0153 ..	3·28
,, in amido acids	0·1774 ..	38·00
,, in amido-acid amids	0·0672 ..	14·38
,, in ammonia	0·0147 ..	3·15
,, in nitrates..	0·0370 ..	7·92
,, in nitrogen bases (Xanthin, &c.)	0·1113 ..	23·83
,, in other forms	0·0441 ..	9·44
Total	0·4670 ..	100·00

A comparison of Tables XIII. and VI. shows very marked differences. The large amount of nitrogen in the molasses in the form of xanthin bodies is especially noticeable, these constituents being almost completely absent in the juice. The xanthin and other nitrogenous bases in the molasses are no doubt largely formed by a breaking up of the nucleo-proteids during clarification, and by the disintegration of the nucleo-proteids during clarification, and by disintegration of the soluble albumoses during the whole process of manufacture.

Among other ingredients which accumulate in the final molasses in large amounts are the organic acids (principally as lime and potash salts) and the gums. These are derived partly as such from the original juice and partly from the decomposition of the sugars, amids, and other organic ingredients during manufacture. Investigations upon these constituents are at present being carried out, and we hope in the near future to give a fuller account of their nature and characteristics.

In concluding this paper a word perhaps may be in place regarding efforts made towards improving the composition of the sugar cane in Louisiana. Attempts to increase the sugar content of the cane by chemical selection have never shown much success, for the reason that the cane is propagated entirely from eyes and not from seed. The discovery some thirty years ago, however, that the seed of the cane would germinate under favourable conditions, has opened up new possibilities, and the testing of new seedling varieties constitutes at present the principal part of the agricultural work of sugar cane experiment stations in all parts of the world.

The first introduction of seedling canes into Louisiana was made in 1893 by Dr. W. C. Stubbs. The great majority of the new canes proved of no value; nevertheless two seedlings from Demerara, the 74 and 95, were found which showed a peculiar adaptability to Louisiana conditions. One of these seedlings especially, the D. 74, is gaining a rapid ascendency over the old Purple and Striped canes, since it yields not only one-third more sugar to the acre, but possesses other characteristics of almost equal importance, such as erectness of growth, quick germinating power, good stubbling characteristics, easy milling properties, and high purity of juices, all of which give the new cane a widely increasing popularity.

The testing of new seedling canes in Louisiana is at present being ably conducted by Prof. R. E. Blouin, and the possibilities of even greater improvements in this direction seem full of promise. By the aid of such improvements, and with the help of unexcelled methods of cane cultivation, the sugar industry of Louisiana, in spite of unfavourable climatic conditions, has every hope of long continuance.

CONSULAR REPORTS.

SWEDEN.

The poor beet crop in 1904 showed its unfavourable results in the increased imports into Sweden of unrefined sugar during 1905.

While the import of this kind of sugar during 1901 and 1902 was exceedingly small and during 1903 amounted to only 1,673 metric tons, it rose in 1904 to 7,037 and in 1905 it came to no less than 19,990 metric tons.

UNITED STATES.

California.—The British Consul-General reports:—

California continues to hold the place she occupied last year in the list of beet sugar producing States, and stands second only to Colorado in the amount of her output. The estimated production for 1905 is 55,000 tons (of 2,240 lbs.) against 52,810 tons in 1904. One additional factory has been in operation this year and another is in course of construction at Visalia. The present year has been a favourable one both for the growing and harvest of beets and the factories have made satisfactory returns.

A large sugar refinery is being established at Crockett in this State, which is expected to commence operations in March, 1906. The site occupied affords the company facilities by rail and water for both receiving and delivering goods. The concern has secured long term contracts by which it controls 82 per cent. of the output of the Hawaiian Islands, and is thus assured of an inexhaustible supply of cane sugar for many years. These exceptional facilities will enable the refinery to compete effectively for the trade of the Pacific Coast. The plant is owned and controlled by a number of Hawaiian planters and their associates in San Francisco. Great benefits will be conferred on the people living in the vicinity of the works as hundreds of workmen will be employed and large sums disbursed for labour and other commodities.

RÉUNION.

The condition of this island from a commercial point of view has still further deteriorated during the year. Sugar, the staple product of the colony, has not shown any improvement; it varied in price between 23 fr. 50 c. the 100 kilos. (220 lbs.) and 24 fr. 75 c. The price of sugar is the never failing barometer of the commercial prosperity of Réunion. Its other products, such as vanilla, rum, &c., are merely secondary. On all sides, from officials, planters, merchants, &c., one hears the same statement that the outlook is a very black one and that only one thing can save the island from ruin and that is a dependable supply of labour.

At present the coolies in the island who are capable of work (*i.e.*, are not too young or too old) number at the most some 6,000 men and women. They decrease annually by about 1,000 by repatriation, effect of the French Nationality Law, and death. Thus in a brief space of time the island will to all appearance be left without any indentured labour whatever.

The amount of sugar exported from Réunion has been as under:—

Year.	Quantity. Metric tons.
1851-60	44,350
1861-70	48,413
1871-80	32,061
1881-90	31,988
1891-1900	38,869
1901-03	39,575

In connection with these figures it must be borne in mind that from 1880 to 1895 the production per hectare (2½ acres) was almost trebled, whilst the sugar extracted from the canes in the mills increased by one per cent. During the same period the land under sugar cane decreased by 40 per cent., principally owing to the lack of sufficient labour. The price of sugar has steadily fallen, and it would seem as if the lowest price had not yet been reached. The price of sugar has fallen from an average of 29 fr. 38 c. per 100 kilos. during the period 1895 to 1899 to 26 fr. 35 c. per 100 kilos. for the period 1900 to 1904; the decrease in the production of sugar in the second period (1900 to 1904) was no less than 7,187 tons as compared with the first period.

The following is the amount of sugar actually exported for the last three years:—

Year.	Quantity. Tons.
1903	19,336
1904	11,314
1905	8,468

The price of sugar in December last was 25 to 26 fr. for a few lots of crystallized sugar for Bombay and 24 fr. 75 c. at Paris, both prices per 100 kilos.

FINLAND.

The imports of raw sugar amounted to 32,913 tons in 1905, against 31,243 tons in 1904. In 1905 the value of the import was £367,960, and in 1904 £324,920.

RUSSIA.

Consular District of St. Petersburg.—The production of sugar during the past season was 1,063,255 tons, of which 870,000 tons were destined for home consumption. There was already a surplus of 64,000 tons left over from the preceding season, and this will be put on the home market as soon as prices rise above the limit fixed officially. The export of sugar from September 14th, 1905, to March 4th, 1906, was about 16,000 tons, against nearly 100,000 tons in the corresponding period of the preceding year. Russia produces about one-fifth of the world's output of sugar; the consumption per head is about one-fifth of that of the United Kingdom. The dividends of sugar factories declared during the Kiev fair, in March, 1906, were one at 2½% (this factory suffered severely during agrarian disturbances), one at 3%, one at 4%, one at 5%, one at 15%, one at 17%, three at 20%, two at 25%, two at 30%, one at 45%.

CHINA.

Hankow.—Imports:—	1905.		1904.	
Sugar—	Cwts.	£.	Cwts.	£.
Refined..	175,550	121,995	120,257	77,406
Brown, white, candy..	272,604	159,756	205,400	114,626
Native net imports—				
Sugar—Brown	116,667	67,366	156,933	89,118
,, White..	108,517	86,106	160,227	129,544

PUBLICATIONS RECEIVED.

THE POLARISCOPE IN THE CHEMICAL LABORATORY. By George William Rolfe, A.M. Macmillan & Co. Price, 8s. net.

Although dealing with the polariscope mainly as an instrument for testing sugar, this volume is an admirable introduction to polarimetric methods in general, including the examination of miscellaneous foods and drugs, and the use of the polariscope in extending our knowledge of the chemical and physical structures of optically active substances.

The fundamental principles underlying polarimetric measurements are clearly and simply explained, and the manipulations of the saccharimeter, its accuracy, and the various sources of error are described in detail.

The subject matter is not, however, entirely confined to optical methods of analysis, a chapter being devoted to the well-known volumetric and gravimetic methods of determining sugars, and an outline sketch is given of the manufacturing processes employed in cane and beet factories and in the production of commercial glucose.

Numerous references appear throughout the work and in an appendix, and the book should prove a useful addition to the library of the technical chemist.

MONTHLY LIST OF PATENTS.

Communicated by Mr. W. P. THOMPSON, C.E., F.C.S., M.I.M.E., Chartered Patent Agent, 6, Lord Street, Liverpool; and 322, High Holborn, London.

ENGLISH.—APPLICATIONS.

11325. J. PICKERING, Glasgow. (Communicated by W. P. Dixon, Australia.) *A continuous centrifugal separator for treatment of sugar and other materials.* 15th May, 1906.

12950. T. B. WAGNER, London. *Improved process of manufacturing anhydrous-grape sugar from corn and analogous farinaceous materials.* (Complete specification.) 2nd June, 1906.

ABRIDGMENTS.

8661. R. J. THOMAS, of Mossman, Queensland, Commonwealth of Australia, and W. F. S. HOWE, of Mossman, as aforesaid. *An improved method of clarifying juices in the manufacture of sugar.* 22nd April, 1905. This invention relates to the manufacture of sugar, submitting the juices while at boiling temperature to electrolytic action within a suitable receptacle whereby a rapid and nearly perfect defecation or clarification of the liquor is produced.

21072. K. DORANT, of Grodzisk, near Warsaw, Russian Poland. *Process for refining sugar.* 17th October, 1905. This invention relates to a process for refinining sugar, characterized by suitable material; for example, clarified or refined crystal sugar, being partially dissolved, and the syrup so formed being used as "refined sugar liquor" for the production of refined sugar, while the remaining eventually specially separated central portions of the original crystals are used as "fine liquor" or "magma liquor," or for other purposes, for example, for granulated sugar.

GERMAN.—ABRIDGMENTS.

167560. C. W. JULIUS BLANCKE & Co., G.m.b.H., of Merseburg a. S. *A regulated valve arrangement for distributing compressed air in vat mashes, more particularly sugar mashes.* 10th February, 1905. This invention has for its object a regulated series of valves for distributing air under pressure in vat mashes, more particularly sugar mashes, in a predetermined succession and at predetermined intervals of time, employing a revoluble cam shaft, and its characteristic feature consists in the valves connected with a compressed air pipe being successively lifted by the cams during one revolution, by means of the constantly rotating cam shaft, which is provided with two cams for each valve, and at the conclusion of the revolution, all the valves are lifted together, or *vice versa*, by the other cams on the shaft.

168030. HENRIETTE BREYER née MITTERBACHER, of Kogel, Lower Austria, and Dr. ALFRED RITTER JURNITSCHEK, of Wehrstedt, Upper Austria. *A method of purifying raw sugar juice by means of a mixture of lime and brickdust.* August 6th, 1904. This improved method of purifying sugar juice consists in a mixture of pulverized caustic lime and brickdust being introduced into the hot juice and it being immediately saturated.

168634. HEINRICH MUELLER, of Brunswick. *A process for obtaining sugar cane juice from fresh or dried beeetroot or sugar cane shreddings and the like, using vacuum.* 1st March, 1905. In this process sugar juice is obtained from fresh or dried beetroot or sugar cane shreddings, beetroot or sugar cane slices, or chop or paste of beetroot or sugar cane, employing vacuum, and is characterized by an extraction vessel being employed which has, after the manner of the "Robert" evaporator, a vertical heating tube arrangement below, surrounded by steam, the pipes of which, intended for heating the extracting liquid, are covered by a sieve, whilst the extraction is effected in the upper part of the vessel.

168780. A. WERNICKE MASCHINENBAU-AKTIENGESELLSCHAFT, of Halle-on-Saale. *An apparatus for making sugar slabs and the like in annular centrifugal insertions.* 15th November, 1904. This invention relates to an apparatus for making sugar plates or slabs in annular insertions, which form a closed whole in centrifugals, by means of which insertions the excess of sugar filled into the sugar moulds for the purpose of obtaining a perfectly uniform filling up of the latter, and which spreads over the inner edge of the insertion after the sugar has been finished being centrifugalled, is removed by being sawn off or the like, and the chief feature of the invention is the arrangement of a circular saw revoluble on a vertical axis, which is inserted into the basket of the centrifugal after the centrifugalling of the sugar has been completed.

168980. HERMANN KINDSCHER, of Tangermünde. *A process for making soluble starch.* November 15th, 1902. (Patent of Addition to Patent No. 149588, of 15th December, 1901.) This patent relates to a process for making soluble starch, in which the raw starch is exposed to the action of an excess of chlorine gas at the ordinary temperature.

169076. SCHNEIDER & HELMECKE, of Magdeburg. *An apparatus for automatically regulating the supply of hot steam for periodically working fluid heating apparatus.* 17th June, 1904. (Patent of addition to Patent No. 146490, of November 22nd, 1902.) This is a modification of the arrangement for automatically supplying the hot steam for periodically working liquid heating apparatus described in the former Patent No. 146490, and is characterized by the arrangement of an auxiliary cylinder receiving the pressure medium, and provided with a piston or diaphragm or the like, and a tap governed by a float which causes the steam valve to open, for the purpose of ensuring the full opening of the valve and its uniform action even under comparatively small difference of level of the liquid to be heated. The opening as well as the closing of the valve is also provided for by means of a pressure medium acting in the auxiliary cylinder, and the governing of the cylinder operated by the difference of temperature of the liquid to be heated with the assistance of electric energy, and the invention is characterized by the piston or diaphragm of the auxiliary cylinder, which piston or diaphragm is connected with the plug of the valve being influenced by a regulating valve, which receives its movement by means of two electromagnets or solenoids which attract an armature mounted on the ends of a two-armed lever, when the auxiliary current produced at the battery by the closing of the maximum or minimum contact of the thermometer, and which passes through a relay and a closed contact, closes the main electric circuit of the respective electromagnet or solenoid, which circuit on the completion of the valve displacement is again opened by means of contacts, whilst the pressure medium entering the auxiliary cylinder operates the opening or closing of the valve plug.

169175. The firm, WILH. GÖLLMANN, of Langerfeld, near Barmen. *A beetroot shredding machine, with means for holding the roots and a rotary knife disc at the bottom of the root holder.* 19th March, 1905. This machine is characterized by a rotation being given to the root holders, which is similar to that of the knife disc but slower, and also by the root container consisting of a fixed upper part and also a lower part connected with the holder and having an insertion which rotates in similar direction to the knife disc but slower than the latter.

169243. ADOLF GUDER, of Ratibor. *A vertical evaporating apparatus, in which the heating of the liquid takes place in pipes round which the hot steam flows, and in which, in order to obtain a circulation, the rising current of liquid is separated from the descending one.* May 20th, 1905. (Patent of addition to Patent No. 160670, of February 23rd, 1904.) This invention is a modification of the vertical evaporating apparatus described in Patent No. 160670, and is characterized by the ends of the discharge pipes proceeding from the liquid distributor being bent off laterally in order to obtain a better distribution of the liquid over the heating pipes.

169365. FERDINAND KAEHL, of Berlin. *Centrifugal arrangement more particularly for the starch manufacture.* 17th March, 1905. (Patent of Addition to Patent No. 155562, of 1st August, 1903.) This invention is an improvement on the centrifugal described in Patent No. 155562 and consists in a knife being arranged in such a way on the horizontal axle of the drum, that the T shaped end of this knife remains constantly in contact with the inner surface of a ring connecting the two halves of the drum in order to protect the discharge apertures from becoming stopped.

169726. TADEUSZ VON LEWICKI, of Warsaw. *A process for retaining the albumens and other non-sugars of sugar beet in the shreddings inside the diffusion battery.* 29th November, 1903. This process for retaining the albumens and other non-sugar substances of sugar beet shreddings inside the diffusion battery, whilst the quantity of juice necessary for mashing the freshly-filled diffuser is forced into a separate stirring mechanism, and from there into the freshly-filled diffuser, is characterized by a small quantity of a precipitant (lime, baryta, &c.) being added to this juice, which is always drawn from the foremost diffuser, after which the juice thus treated enters in the same direction into the diffuser filled with fresh shreddings, whence it is afterwards forced to the measuring vessel.

169727. OTTO BERNARD BARTH, of Loveland, Colorado. 31st May, 1905. *An apparatus for separating sugar and syrup from masse-cuite.* This apparatus consists of a cylinder, provided with screw threads and perforated and divided by a partition into two chambers, which revolves in the interior of a fixed cylinder which is also perforated, and thus forces the masse-cuite downwards, with the object of drawing to the outside the syrup contained in the mass through the outer cylinder into chambers external to it, whilst the sugar, which has been further washed with water and blued in the ordinary way, is withdrawn from the bottom of the apparatus. A modification of the apparatus consists in the perforated rotating cylinder, provided with spiral threads, being provided with a central steam pipe for the purpose of casing the masse-cuite. Another modification of the apparatus consists in a receiving vessel being provided beneath the outer apparatus, into which the sugar is introduced automatically by the progressive uncovering of apertures provided in the bottom plate.

NOTE.—Copies of all published specifications with their drawings in these lists can be obtained from W. P. Thompson & Co., 6, Lord Street, Liverpool, at One Shilling a copy for English or American Patents, and Two Shillings for German. In ordering please give number and date.

Patentees of Inventions connected with the production, manufacture and refining of sugar will find *The International Sugar Journal* the best medium for their advertisements.

The International Sugar Journal has a wide circulation among planters and manufacturers in all sugar-producing countries, as well as among refiners, merchants, commission agents, and brokers, interested in the trade, at home and abroad.

IMPORTS AND EXPORTS OF SUGAR (UNITED KINGDOM)

To end of May, 1905 and 1906.

IMPORTS.

Raw Sugars.	Quantities.		Values.	
	1905. Cwts.	1906. Cwts.	1905. £	1906. £
Germany	1,185,583	4,003,145	806,089	1,704,443
Holland	74,451	44,206	54,731	16,641
Belgium	270,852	200,572	203,756	81,209
France	77,747	158,805	57,718	67,251
Austria-Hungary	223,942	130,682	165,062	54,207
Java	1,254,567	158,992	931,101	73,466
Philippine Islands	....	....	....	....
Cuba	....	111,910	....	41,943
Peru	665,869	322,150	488,810	145,868
Brazil	27,828	883,237	18,087	341,859
Argentine Republic	....	....	....	....
Mauritius	134,997	52,523	76,142	20,368
British East Indies	190,385	31,078	102,640	11,742
Straits Settlements	87,664	38,480	44,014	16,257
Br. W. Indies, Guiana, &c.	647,037	837,456	552,265	480,924
Other Countries	570,365	142,017	412,510	65,849
Total Raw Sugars	5,411,287	7,115,253	3,912,925	3,122,027
Refined Sugars.				
Germany	3,841,230	4,768,666	3,283,435	2,715,224
Holland	544,799	1,106,707	483,985	658,052
Belgium	112,429	129,211	98,578	75,642
France	500,011	833,958	433,598	463,755
Other Countries	230,996	390	189,372	260
Total Refined Sugars	5,229,465	6,838,932	4,488,968	3,912,933
Molasses	930,379	1,144,516	197,107	218,332
Total Imports	11,571,131	15,098,701	8,599,000	7,253,292

EXPORTS.

British Refined Sugars.	Cwts.	Cwts.	£	£
Sweden	184	127	168	114
Norway	8,247	7,323	6,924	4,422
Denmark	27,636	44,706	21,898	22,705
Holland	30,619	33,412	25,666	19,646
Belgium	2,459	4,129	1,863	2,224
Portugal, Azores, &c.	6,568	16,789	5,233	9,032
Italy	726	16,333	546	8,467
Other Countries	92,583	248,503	88,684	159,743
	169,022	371,322	150,982	226,353
Foreign & Colonial Sugars				
Refined and Candy	7,162	13,613	7,035	8,533
Unrefined	20,784	101,411	16,584	53,768
Molasses	419	5,175	204	1,590
Total Exports	197,387	491,521	174,805	290,244

UNITED STATES.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1906. Tons.	1905. Tons.
Total Receipts Jan. 1st to June 21st	1,028,006	923,985
Receipts of Refined ,, ,,	1,130	698
Deliveries ,, ,,	1,046,750	854,972
Consumption (4 Ports, Exports deducted) since January 1st	856,290	763,555
Importers' Stocks June 20th	39,789	69,013
Total Stocks, June 27th	342,000	227,920
Stocks in Cuba, ,,	243,000	334,000
	1905.	1904.
Total Consumption for twelve months	2,632,216	2,767,162

CUBA.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1905 AND 1906.

(Tons of 2,240lbs.)	1905. Tons.	1906. Tons.
Exports	633,641	731,945
Stocks	381,509	323,206
	1,015,150	1,055,151
Local Consumption (five months)	19,130	19,480
	1,034,280	1,074,631
Stock on 1st January (old crop)	—	19,450
Receipts at Ports up to May 31st	1,034,280	1,055,181

Havana, May 31st, 1906.

J. GUMA.—F. MEJER.

UNITED KINGDOM.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION FOR FIVE MONTHS ENDING MAY 31ST.

	IMPORTS.			EXPORTS (Foreign).		
SUGAR.	1904. Tons.	1905. Tons.	1906. Tons.	1904. Tons.	1905. Tons.	1906. Tons.
Refined	363,548	261,473	341,947	568	358	681
Raw	316,954	270.564	355,763	2,380	1,039	5,071
Molasses	38,512	46,519	57,226	7	21	259
Total	719,014	578,556	754,936	2,955	1,418	6,011

	HOME CONSUMPTION.		
	1904. Tons.	1905. Tons.	1906. Tons.
Refined	377,955	259,130	327,999
Refined (in Bond) in the United Kingdom	209,354	206,878	229,102
Raw	51,355	41,438	49,820
Molasses	33,874	45,854	55,044
Molasses, manufactured (in Bond) in U.K.	26,866	22,103	27,965
Total	699,404	575,403	689,930
Less Exports of British Refined	11,393	8,451	18,566
Total Home Consumption of Sugar	688,011	566,952	671,364

STOCKS OF SUGAR IN EUROPE AT UNEVEN DATES, JUNE 1ST TO 23RD, COMPARED WITH PREVIOUS YEARS.

IN THOUSANDS OF TONS, TO THE NEAREST THOUSAND.

Great Britain.	Germany including Hamburg.	France.	Austria.	Holland and Belgium.	TOTAL 1906.
176	1022	599	474	206	2478

	1905.	1904.	1903.	1902.
Totals	1725	2260	2247	2382

TWELVE MONTHS' CONSUMPTION OF SUGAR IN EUROPE FOR THREE YEARS, ENDING MAY 31ST, IN THOUSANDS OF TONS.

(Licht's Circular.)

Great Britain.	Germany.	France.	Austria.	Holland, Belgium, &c.	Total 1905-06.	Total 1904-05.	Total 1903-04.
1753	997	634	506	179	4070	3939	4030

ESTIMATED CROP OF BEETROOT SUGAR ON THE CONTINENT OF EUROPE FOR THE CURRENT CAMPAIGN, COMPARED WITH THE ACTUAL CROP OF THE THREE PREVIOUS CAMPAIGNS.

(From Licht's Monthly Circular.)

	1905-1906.	1904-1905.	1903-1904.	1902-1903.
	Tons.	Tons.	Tons.	Tons.
Germany	2,425,000	1,598,164	1,927,681	1,762,461
Austria	1,510,000	889,373	1,167,959	1,057,692
France	1,085,000	622,422	804,308	833,210
Russia	1,000,000	953,626	1,206,907	1,256,311
Belgium	330,000	176,466	209,811	224,090
Holland	210,000	136,551	123,551	102,411
Other Countries	410,000	332,098	441,116	325,082
	6,970,000	4,708,758	5,881,333	5,561,257

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☞ The Editor is not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

NOTES AND COMMENTS.

The Honolulu Ironworks Company.

Some particulars are given in a recent issue of the Hawaiian *Planters' Monthly*, relating to the Honolulu Ironworks Company, well known as the leading engineering firm of Hawaii. We gather that the Company was established in 1853 by Mr. D. W. Weston, the inventor of the well-known design of centrifugals. In 1896, when it was incorporated a second time, nearly all the sugar factors in Honolulu became shareholders, and new modern works were then erected. These works occupy 6½ acres of land, with the usual engineering shops, all equipped with the most modern appliances, including hydraulic, electric, steam, and compressed air plants, and with 20-ton overhead travelling cranes of 60 ft. span. The number of employees varies from 300 upwards; the offices require eight draughtsmen, and 15 to 20 clerks and storekeepers. Obviously this firm have secured most of the orders for local sugar machinery. While about a dozen modern mills of foreign make are at present working in the Islands, the Ironworks Company has over 30 modern 9-roller mills in operation and five 12-roller mills, besides a number of older types of mills. Some of the factories equipped by them have daily capacities for cane of over 1000 tons. Puunene (2400 tons), Ewa (2000 tons), Oahu (1450 tons), and Olaa (1100 tons) may be cited as instances. Besides large local orders, this firm has secured one for a new factory and distillery (capacity 1200 tons of cane per diem) for the Oaxaquena Plantation, Mexico. This shows that the Honolulu Ironworks Company are to be seriously reckoned with in the present competition for sugar machinery, and can no longer be considered as a purely local concern.

The American Denatured Alcohol Bill.

The Bill providing for the use, free of revenue tax, of denatured alcohol, has just been passed by Congress, and signed by the President. The denaturent prescribed is methyl alcohol, and the operation of rendering the spirit unfit for internal consumption has to be carried out in bonded warehouses, under the supervision of Government inspectors. The new arrangement comes into force next January. We congratulate the United States on having passed such a valuable industrial measure. It will give an immense fillip not only to beet and potato farmers, but to all users of internal combustion engines, as it is expected to outbid gasoline (petrol) in utility and price. But we may point out that many of the advantages claimed for alcohol in a recent number of an American sugar contemporary are wide of the truth. Thus alcohol has not, as alleged, nearly *twice* the heating power of gasoline. The approximate figures give alcohol a thermal value of 28,500 B.T.U., and gasoline one of about 20,000. Again alcohol *is* explosive, otherwise how could it be of use in internal combustion engines. The most important point after all is this. Alcohol has an advantage over other liquids for use in "gas" engines because it can be made to convert a greater percentage of its available heat into power. In other words, when alcohol is used in an internal combustion engine, less of the heat generated in combustion goes into the cooling water or into the waste gases than is the case where gasoline is used as fuel. But it must be noted that existing gas engines can *not* burn alcohol economically without radical and considerable alterations.

Leeward Islands Sugar Cane Experiments.

The sugar cane experiments carried out in the Leeward Islands during 1904-05 are described in the usual bulky foolscap pamphlet prepared by Dr. Francis Watts, C.M.G., and recently issued. The total area employed for these experiments was 96 acres, divided between Antigua and St. Kitt's. Unfortunately the climatic conditions in Antigua were again unfavourable. The severe drought which was experienced reduced the sugar crop of the island from the average of 13,000 tons to 7,800 tons. However, the experiments here showed seven canes as specially worthy of attention; these were *B. 156*, *Sealy Seedling*, *B. 306*, *B. 208*, *D. 74*, *D. 95*, and *D. 109*. It is noteworthy that the first six of these also appeared as the premier six in the previous season's results. They are, therefore, considered worthy of being safely albeit cautiously introduced into cultivation in Antigua. At St. Kitt's the best results for plant canes were obtained with *Caledonian Queen* or *White Transparent; B. 208* and *B. 147* were also grown with satisfactory results. *B. 208* heads the list of canes grown as *ratoons* in these experiments with a yield of 30 tons of cane and 8,508 lbs. of sugar in the juice. There was, it is gratifying to note, an almost complete absence of rotten canes in the fields throughout this colony. In the opinion of Dr. Watts this is directly traceable to the introduction of new varieties of cane; accordingly, it would appear that the great value and importance of these experiments are amply established. Appended to the Report is an interesting paper on the "True and Apparent Quotients of Purity of the Juice of 35 Varieties of Cane." This paper, which is a contribution to a subject introduced at length by Mr. H. C. Prinsen Geerligs in our pages in 1900, will be found in full on another page of this *Journal*.

Mr. Chamberlain's 70th Birthday.

Last month witnessed the celebration of Mr. Joseph Chamberlain's 70th birthday, and the occasion was seized by his hosts of friends and admirers, imperial, political, and municipal, to do him honour. For that purpose Birmingham was *en fête* for several days, and banquets, meetings, illuminations, and a torchlight procession filled up the programme. Not the least significant feature of this celebration was the immense number of telegrams of congratulation which this "Missionary of Empire" received from all parts of the world. And that his views of Imperial preference and protection against the foreigner have not lost ground amongst all thoughtful people is well shown by the fact that at the sixth Congress of Chambers of Commerce of the Empire, held about the same time in London, there was a discussion on the fiscal question, and in the end a resolution in favour of Imperial preference was carried by 105 Chambers against 41, 21 remaining neutral. That this should occur so soon after the Liberals had made a clean sweep of the country shows how much solid opinion is supporting the plea for fiscal reform.

Should the Sugar Convention be renewed?

The following remarks appearing in the *British Trade Journal*, are well worth reproducing:—

In September, 1907, the British Government will have to give notice whether or not it will withdraw from the Brussels Sugar Convention in 1908, when the five years' period for which the Convention was signed will expire. There is ample time, therefore, in which to discuss the pros and cons and the advantages and disadvantages of a renewal on the part of the United Kingdom. Much may happen between now and September, 1907, but whatever Government may be in power, the question will have to be considered from many points of view. One possibility which, so far, seems to have escaped attention is that the other members of the Convention may prefer to dispense with the adhesion of the United Kingdom, and carry on the Convention among themselves rather than revert to the old mistaken policy of bounties and cartels.

Should the foreign parties to the Convention take up that line of policy, we should have to consider what the position of the United Kingdom would then be. As we have from the first co-operated with the other Powers in drawing up the various clauses in the Convention imposing fines on bounty-fed sugar, the British Government cannot object if other countries maintain these clauses. Nor could we object if countries which may remain members of the Convention should impose fines on British sugared products when exported by the United Kingdom while the United Kingdom imports bounty-fed sugar from countries such as Russia. The quantities of sugared products which we export may not be very extensive, but if such products are penalised in the Convention countries our manufacturers of jams, condensed milk, chocolate and similar goods would be injured, and it is desirable, therefore, that they should look at the question from this point of view, for it puts forth a policy, which, we believe, has greater chances of being adopted than is generally supposed.

New Central Factories.

The Sena Sugar Factory, Ltd., of which C. Czarnikow, Esq., of Mincing Lane, London, is the Chairman, have placed the contract for their new central sugar factory with the well-known firm of Harvey Engineering Co., Ltd. (late McOnie, Harvey & Co., Ltd.), of Glasgow. This is the ninth contract for complete cane sugar factories which this firm have received during the last five years, and justifies the high reputation which they hold in this special branch of engineering. They are now completing the shipment of a large complete refinery for India, to produce high quality sugar without the use of charcoal, which latter is not permitted by the Hindoo creed. They have also just secured the contract for a large complete sugar refinery for Japan, the kiln, char, and blow-up portion of which is being constructed by Messrs. Buchanan & Sons, of Liverpool.

These orders are another proof of the great advance that the cane sugar industry is making all over the world now that it is given a fair field, the Continental beet having to compete with it on fair and equal terms. The great improvement in cane sugar machinery, even in the last five years, has considerably reduced the cost of manufacture, but still greater improvements are possible in the cultivation of the cane by irrigation, the use of steam ploughs, and the selection of canes to suit the soil and condition of the ground; and these improvements are steadily being introduced.

THE INTERNATIONAL SUGAR COMMISSION AND BRAZIL.

The official Report of the last Session of the Permanent Commission at Brussels has just been issued. From it we learn that the chief subject under investigation was the Brazilian sugar question. To quote the report, "it will be recollected that at the Autumn Session of the Commission it was decided that the application of countervailing duties to Brazilian sugars should continue to be suspended until the next meeting in the spring, in order that further and more complete inquiry might be made as to whether the existing system in Brazil did or did not in fact result in a bounty of any kind. It was therefore agreed that the Permanent Bureau should make an investigation on certain definite points, and the British Delegates undertook to recommend to His Majesty's Government that an independent inquiry should also be instituted by His Majesty's Consular staff in Brazil. As a result of this, several documents were printed and circulated to the various delegates. One was a report by the Permanent Bureau, another a report by Mr. Rhind, British Vice-Consul at Rio de Janeiro.

A note by the British delegation had also been prepared in London and circulated to the members of the Commission before the meeting; it summarizes the conclusions at which the British delegation had arrived, after perusal of the various documents above mentioned, to the effect that recent investigations clearly demonstrated that no bounty, direct or indirect, existed in Brazil.

This last report was as follows:—

BRAZILIAN SUGAR LEGISLATION.

Note by the British Delegation on the results of the Inquiry instituted by His Britannic Majesty's Government.

In pursuance of the understanding arrived at at the last meeting of the Permanent Sugar Commission, His Britannic Majesty's Government have instituted an independent inquiry into the conditions prevailing in the Brazilian sugar industry. The report of Mr. Rhind, His Britannic Majesty's Vice-Consul at Rio de Janeiro, embodying the result of his inquiries, is now before the Commission.

Mr. Rhind's report gives information which enables a definite answer to be given to the following questions:—

(*a*) Is there in operation in Brazil any system of direct or indirect subsidy to the sugar industry of the nature of a bounty?

(*b*) Are there any cartels in Brazil for the purpose of subsidizing the export of sugar out of the profits of the home trade, and is there any prospect of such cartels being successfully formed in the future?

(*c*) Is there any difference of price of identical qualities of sugar sold for internal consumption or for export abroad, at the place of production?

(*d*) Is the high price of sugar for home consumption in the great consuming centres such as Rio entirely attributable to high cost of transport and other charges which can be identified, or does it include an element of excessive profit to the producer which might be utilized to encourage export at low prices?

(*e*) If the high surtax is not used to facilitate the export of sugar, why is it considered necessary to keep it so much above the figure recognized by Article III. of the Convention?

(*f*) Do the differential export duties imposed by some States operate as bounties on export abroad?

The above appear to be the only questions of fact which have any material bearing on the question before the Commission.

To take the above questions in order:—

(*a*) Mr. Rhind answers this question in the negative. There seems no intention on the part of the Brazilian Government to act on Clause 11 of the New Revenue Law, and no appropriation has been made in the Budget for the purpose, the clause having apparently been introduced into the law on sentimental grounds so as not to appear to favour coffee at the expense of sugar. The small premiums or prizes contemplated by the State of Alagoas have never been paid, and the Decree authorizing them has been rescinded.

(*b*) This question is also answered in the negative. The local associations called "Syndicates" are shown to have nothing in common with cartels for subsidizing export by raising home prices. All attempts to form the latter kind of combination have signally failed, and Mr. Rhind shows that the causes of failure are so deep-seated that success is practically impossible in future. Nothing but a combination, including all the great sugar-producing districts, could operate with success, and this is illustrated by the total failure of the attempt of the Campos sugar-producers to affect prices by exporting 20,000 bags of sugar to the United States in 1905. The great extent of territory, the large number of small producers, and the absence of any cohesion or loyalty among them are among the reasons rendering a successful general cartel impossible. It may be added that Mr. Rhind's conclusion under this head is fully supported by theoretic considerations. A sectional combination (*e.g.*, Campos), however complete, could not permanently control the price of sugar in Rio, which is largely supplied by Pernambuco. This being so, it could not be to its real interest to limit the quantity of Campos sugar put on the Rio market by exporting abroad at less than cost.

(*c*) Mr. Rhind answers this in the negative. The predominant part of the export trade is conducted on the basis of firm orders sent to Brazil from foreign markets, on the basis of fair market prices ruling at the time. Much of the misapprehension as to the alleged difference between prices for home and foreign consumption appears to be due to the practice of quoting in market reports nominal prices for qualities of sugar in which no real trade is done. In Pernambuco the prices (exclusive of export duty) for the qualities both consumed locally and exported are identical. The same is true of Alagoas, Bahia exports no sugar, and Campos sugar is almost all sent to Rio, prices in Campos itself being lower by about 7·20 fr. per 100 kilogs. than in the town of Rio, owing to the cost of freight, export duty, &c.

(*d*) The annexes to Mr. Rhind's Report show conclusively that the high price of sugar (say at Rio) is entirely accounted for by the high charges for putting it on the Rio market. To take Pernambuco sugar as an example, "Brancos" sugar in Pernambuco cost 140 to 180 reis per kilogramme in the last week of December, 1905, whether for home use, export to other States, or export abroad. The cost of transport, loading and unloading, brokerage, warehouse charges, export duty, &c., to Rio amount to about 70 reis, making a total of 210 to 250 reis, or a mean of 230 reis.

As the wholesale price at Rio appears to have been 220 to 248 reis for Brancos at the same period, it is evident that the whole difference between that price and the export price at Pernambuco is accounted for. Similar comparisons might be readily made for other grades of sugar or other producing and consuming markets with the same result.

(*e*) On this point valuable light is thrown by Mr. Rhind's observations on the wide fluctuations of exchange, whilst the desire of the Brazilian Government to reduce the import duty so far as is in their opinion compatible with the efficient protection of the home market is indicated by the issue of a Decree establishing a rate of 200 reis per kilogramme as against the rate of 1,000 reis previously in force.

(*f*) The export duties as between the States are shown by Mr. Rhind to operate like excise duties. Take the case of Pernambuco, whose production is 2,500,000 bags of 75 kilogs., equivalent to about 3,000,000 bags of 60 kilogs. On the basis of population the consumption of sugar within the State of Pernambuco is probably not more than 200,000 bags of 60 kilogs., or say seven per cent. of its total production. Except for this insignificant fraction, the whole of the produce of Pernambuco consumed in Brazil pays the export duty. The remission of the whole or part of this duty on sugar exported abroad is therefore virtually equivalent to a remission of excise, which is universally admitted as legitimate. It may also be observed that the view that the Pernambuco export is in effect a tax on consumption is expressed by the Belgian Consul in that town, who writes, "C'est un véritable impôt de consommation au profit de l'État de Pernambouc."

These observations, together with Mr. Rhind's Memorandum, are presented to the Permanent Commission in response to the desire expressed by some of its members to be furnished with the results of an independent inquiry. It is submitted that they clearly establish the fact that no bounty, direct or indirect, exists in Brazil.

Mr. Rhind's Report is naturally a very valuable one, giving as it does a general survey of the Brazilian sugar industry. On another page we reproduce some chief portions of it.

Messrs. John McNeil & Co., of Glasgow, have under construction one of the largest, if not actually the largest, eleven-roller sugar cane crushing plants ever ordered in this country. The mills are 36 ins. dia. by 6 ft. 6 ins. long, and have journals 18 ins. dia. The whole eleven rollers are driven by one engine.

A METHOD FOR THE PREPARATION OF CANE PRODUCTS FOR POLARIMETRIC ASSAY.

By Noel Deerr.

Although the use of basic lead acetate is universal in the preparation of sugar products for polarimetric assay, its use is known to introduce certain errors and inconveniences, and a substitute for its use has perhaps been desired by those engaged in the analyses of sugars and allied products.

Of other reagents may be mentioned mercuric compounds, largely used in the clarification of milk; alumina cream, and bone black. In addition, chloride of lime, first used by Zamaron,* has been recommended by Pellet in special connection with the preparation of cane molasses.

The effect of alumina cream is entirely mechanical, and it only finds a use in removing an opalescence or in clearing a very faintly-coloured solution. When, however, the alumina is precipitated within the body of the solution which it is desired to clarify, a definite chemical action seems to take place, the alumina at the moment of its formation uniting with colouring and other matters present, and forming with them insoluble bodies. This action is similar to the use of alum mordants in the dye industry, whereby insoluble "lakes" are precipitated on the fibres of animal and vegetable tissues. Alumina may be precipitated within a solution by the action of alkalies on a soluble alum or by the reverse reaction by neutralizing a solution of potassium or sodium aluminate by means of an acid. Either of these processes, when carried out in a cane juice or solution of a sugar house product, produces a notable precipitation of colouring matters, and after filtration a negotiable material may under certain conditions be obtained.

When clarifying sugar products by this method, the two precipitants must be added to the material in almost equivalent quantities, or at most so as to give a very faint acid reaction to the material. Any excess of acid or alkali results in the resolution of the alumina and of the co-precipitated bodies, and in this respect an excess of alkali is more objectionable than an excess of acid.

This difficulty may be overcome by using as the precipitating agents sodium aluminate and a soluble alum. The method which I have found to give the best results is as follows:—

To 50 cc. of the material under analysis a certain quantity of a 10% solution of sodium aluminate free from carbonates is added, the contents of the flask mixed, and then a slight excess of a saturated solution of sulphate of aluminium. The volume is then completed to 100 cc., violently agitated and filtered. When using the process in the polarimetric assay of a sugar, the normal weight is first dissolved in about 50 cc. of water, clarification effected as described above, and the volume completed to 100 cc. Absence of carbonates from the solution of sodium aluminate is necessary, as in this case the frothing which takes place on the addition of the alum prevents the material being made up accurately to a definite volume.

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* Bull. de l'Assoc. des Chim., XVI. 337.

The addition of the sodium aluminate results first in the solution becoming both clearer and darker. On the addition of the alum the formation of a dark-coloured precipitate occurs, which, on the continued addition of the alum changes in the case of juices to a slate grey, and in the case of molasses is yellowish. The slate grey colour appears when the mixture is faintly acid to litmus, and is an indication that sufficient alum has been added.

According to the concentration and nature of the material under analysis, different quantities of alumina are required to effect the maximum decoloration. The largest quantity is naturally required in the case of molasses, and in this case I have found that 50 cc. of a solution of molasses of density 12° Balling require a maximum of 5 cc. of a 10% solution of sodium aluminate. First products require less, and with juices 3 cc. per 50 cc. of juice is always sufficient. When working with this method it is not feasible to dilute a juice from 50 to 55 cc., as if 3 cc. of sodium aluminate be used more than 2 cc. of a saturated solution of alum are required to neutralize the aluminate, and I have found it convenient to make up the 50 cc. of juice to 100 cc.

So far as regards the applicability of the process, the best results are obtained with products that are naturally light-coloured, such as in the polarization of refining crystals made without boiling in molasses with direct consumption sugars and with mill juices ; when applied to mill juices shortly after expression, or to non-macerated juices, results are but little inferior to those obtained by the use of basic lead acetate. With macerated juices, less satisfactory results are obtained. With refuse molasses, a concentration such that a reading of about 7 Ventzke degrees results is the highest that can be obtained without the solution being darker than can be read with accuracy.

Animal charcoal, which was formerly largely used in sugar analysis does not now, I believe, find an extended use; but in combination with the process detailed above, even with refuse molasses, filtrates but little inferior to those obtained with the use of basic lead acetate result. The method of applying animal charcoal that I have found most satisfactory is to shake up the filtrate from the alumina precipitate with a small quantity of finely powdered dry charcoal and to again filter. Occasionally the material when thus treated does not filter brightly, and in this case the addition of one drop each of the aluminate and alum solutions will give a bright and very highly decolorised filtrate. Under these conditions concentrations of refuse molasses giving a reading of 15 Ventzke degrees can be observed.

In common with lead acetate the process described above introduces error due to the volume of the precipitate: this error is capable of being allowed for by the same methods that are used for the lead precipitate, and in an experiment with a pure sugar it was found that the volume of the alumina precipitated from 5 cc. of a 10% solution of sodium aluminate was ·58 cc.

Cane juices clarified in this way filter with fair ease and are capable of being filtered through asbestos over reduced pressure and the precipitate is capable of being washed. For this purpose I have used a filter plate two inches in diameter; the whole of the sugar is thus capable of being washed out and the filtrate being made up to definite volume error, due to the volume of the precipitate is removed. Such a process, however, is too lengthy to be used except for special purposes.

In some special cases other than in its general application I have found this process of considerable use.

In my experience megass extracts obtained by long boiling of megass, in the presence of small quantities of lead acetate, often give a filtrate lacking brightness. The addition of two drops of the aluminate per 100 cc. of extract produces a precipitation of alumina and after filtration the extracts are so clear that they may readily be observed in a 60 cm. tube.

It is often of interest to test waste factory waters by one or other of the colour reactions of sugar. In this colony (Demerara) the waste waters are naturally so dark coloured as to obscure any of these tests. These waters may be obtained almost colourless by the precipitation within them of very small quantities of alumina.

In the assay of glucose in sugar juices the removal of lead adds to inconvenience of the process; juices clarified by the method described can, I think, be used at once for a glucose assay.

The process described above is perhaps capable of a wider range of application than to sugar house products, as I find that milk can readily be clarified by this process so as to be obtained in a condition suited for polarimetric assay.

The preference granted by Canada to West Indian sugar is having good results. Not a pound of Trinidad sugar found its way to the U.S.A. last crop.

SIMPLE METHODS OF CHEMICAL CONTROL.

By T. H. P. Heriot, F.C.S.

(Concluded from page 357.)

XIV.

The Control of the Fuel.

To run a sugar factory on economic lines it is not sufficient to recover the maximum quantity of sugar, but to do this at the lowest possible cost both in labour and material, including that important item—fuel.

Now, on this score, the cane sugar industry has an enormous advantage over that of the beet, since the crushed cane, or megass, is a fuel which costs nothing, and is already on the spot. With modern boilers and specially designed furnaces no other fuel is required; indeed, the problem is rather how to dispose of the surplus megass, or to utilize the surplus steam when the whole of the megass is sent to the furnaces.

That a cane sugar factory can entirely dispense with a fuel account is not sufficiently recognized, judging from the number of factories where wood, or even coal is burned in addition to the megass, or where the furnaces are of so antiquated a type that the megass has to be sun-dried before it can be used as fuel. When the wages paid for cutting and transporting wood, or for sun-drying the megass, are recorded as "fuel," it is found that steam is frequently a costly item of the working expenses.

First, then, as regards the megass. If sun-drying has to be resorted to it is important to know when the proper degree of dryness has been obtained so that labour may be economized.

An experienced stoker may be able to distinguish between well dried and badly dried megass by the sense of touch, but if we would control his work we must have an independent check, free from all errors of judgment.

Such a check we have in the *Megass Test*, described in Chapter VIII. Five pounds of sun-dried megass will be sufficient to fill one of the wire cages, and the drying operation should be complete in from 2 to 3 hours. Care must be taken to secure samples representing equal parts of the upper and lower layers, and taken from different spots in the factory yard. If the sun-drying has been sufficient the loss in weight should not exceed 15%; that is $\frac{3}{4}$ lb. on the 5 lbs. of megass tested.

As regards the fuel-value of ordinary "wet" megass no very exact data are available. One ton of good Scotch coal is equivalent to from $3\frac{1}{2}$ to four tons of megass from a double-crushing mill, and to 4 or 5 tons of single-crushed megass.

In factories burning coal, the first step towards economy is to know that the quality of the coal supplied is proportional to the price paid for it; the second step being to see that the heating value of the coal is utilised to the best effect by skilful stoking.

Whenever practicable, a sample taken from each shipment of coal should be submitted to an analyst who will report on the heating value and percentage of ash for a moderate fee. When such advice is not available, the heating value may be determined in the factory laboratory by means of an apparatus called a Calorimeter (*i.e.* heat measurer). This is a device for burning a weighed quantity of coal in such a manner that the whole of the heat evolved is absorbed by a large volume of water, the rise in temperature of which is very accurately measured. In either case, the first step is to secure an average sample of coal from the bulk.

Sampling.—Two lumps, of average size, are taken from each truck—or punt-load, and broken into small pieces by means of a hammer upon a clean concrete floor. The large sample, thus obtained is then mixed by shovelling the outlying fragments towards the centre of the heap until the latter assumes the form of a cone with circular base. This operation is next reversed by raking the coal from the centre of the heap towards the circumference, repeating this all round until a layer of uniform depth is secured. A straight-edge of wood, or metal, is pressed down upon the sample in such a manner as to divide the heap into two equal portions, which can then be slightly separated by pushing the straight edge side ways. A similar dividing line is then made at right-angles to the first, by which means the whole sample is divided into quarters. Alternate quarters are then removed, together with the fine dust belonging to them, and the remaining quarters re-mixed to form a smaller cone which is flattened out, quartered, and two alternate quarters removed as before. In this manner the sample can be greatly reduced in bulk, whilst still fairly representing the original sample. When only about 10 pounds remain, this residue must be crushed to a coarse powder in an iron mortar before the "quartering" can be carried further. The powdered coal, after mixing, is spread out upon a large sheet of paper and repeatedly "quartered" until a sample weighing about 1 pound is obtained.

The above operations may appear unnecessarily tedious, but in the absence of special apparatus no simpler methods of sampling can be relied upon.

The Coal Test.—Printed instructions for using the Calorimeter are supplied with the apparatus, but these being somewhat condensed we will attempt to simplify this very interesting test, commencing with a few words of *Theory*. Measurements of various kinds can only be expressed in terms of some arbitrary unit; for example, the inch, the gallon, the pound, &c. In the case of heat, it is very necessary to distinguish between *quantity of heat* and *temperature*, since the same quantity of heat produces different temperatures when applied to different substances. But to raise the temperature of a gallon of water from, say, 60° to 61° F., the same *quantity of heat* will always be required, and thus affords a basis of measurement.

The metrical system of weights and measures being much more convenient in scientific work, the unit now universally adopted is the quantity of heat required to raise the temperature of one kilogram of water one degree Centigrade. Adopting this unit, which is known as a *calorie*, the heating power, or calorific value, of fuels can be conveniently expressed in terms of the number of calories developed on burning one kilogram of fuel.

The Calorimeter is designed to burn only 2 grams of coal, the heat evolved being absorbed by 2 kilograms of water. For each degree Centigrade that the temperature of this water is raised, two calories will have been set free by the combustion of the coal (there being two kilograms of water heated instead of one, see definition given above). Again, as only 2 grams of coal are used in the test, the quantity of heat measured must be multiplied by 500 to obtain the heating effect of a kilogram (1000 grams) of coal. Consequently the number of degrees Centigrade through which the 2 kilograms of water are heated must be multiplied by 2 × 500, or 1000, in order to arrive at the true calorific value of the coal tested.

The Apparatus comprises 5 parts:—

1. A metal cylinder, terminating above in a metal tube with tap and having a double row of perforations below.
2. A circular metal base, to which the said metal cylinder can be attached by means of springs.
3. A metal tube, or cartridge, to hold the combustibles, and which can be fixed vertically in the centre of the metal base. Cartridges of two sizes are supplied with the apparatus; the shorter tube being alone used for testing coal.
4. A large glass cylinder in which the above apparatus can be immersed in water.
5. A delicate thermometer graduated in tenths of a degree C.

Instructions.—It being desirable to know the temperatures of the laboratory, the thermometer may be left exposed on the table whilst the following preparations are made.

The one-pound sample must be re-ground in the iron mortar until the whole can be passed through the metal sieve. Two grams of this fine dust are carefully weighed into the counterpoised metal basin and then emptied into the wedgewood mortar; the latter having been previously heated for about ½ hour in the megass drying-chamber. It is once again ground up with the pestle, the heat of the mortar serving, at the same time, to remove any traces of moisture. To it are added 26 grams of oxygen mixture,* and the two powders mixed by grinding until the mixture assumes a uniform grey colour.

This mixture has next to be transferred, without loss, to one of the short metal cartridges in the following manner:—

The mortar and cartridge (the latter upright) are placed side by side on a sheet of smooth writing-paper. By aid of the steel spatula the mixture is then transferred from the mortar to the cartridge in small quantities, tapping the base of the cartridge upon the table after each addition in order to compress the charge and thus render its combustion rapid and uniform.

During these manipulations any accidental spillings should fall upon the paper placed to receive them and to these are added the last traces of mixture from the mortar by dusting out the latter with a camel-hair brush. Folding the paper almost double the last of the mixture is easily brushed direct into the metal cartridge, which should now be quite full. If there appears more of the mixture than the cartridge will hold, it is because the charges have not been sufficiently compressed, in which case the remedy is obvious.

To fire the charge the cartridge must finally be fitted with a fuse, prepared by soaking lamp-cotton in a strong solution of nitre, and drying. A length of about an inch is sufficient, a quarter of which is pushed into the charge leaving ¾in. protruding. The cartridge is then inserted in the metal base and covered by the metal cylinder, the tap on which is closed.

After carefully observing the air temperature of the laboratory, a bucketful ef cold water is procured and its temperature also observed. If a few degrees Centigrade below the air temperature, so much the better; but, if not, a lump of ice should be added until the temperature falls 7°C. below that of the air. After removing the ice, the water is poured into the large glass cylinder exactly to the level of the 2000°cc. mark on same, which is the volume occupied by two kilograms of water. Holding the metal apparatus just above the tap, lower same into the cylinder until it rests at the bottom with only the tap projecting above the surface of the water. In this position, the metal cylinder remains full of air so long as the tap is closed, and there is no risk of the enclosed charge being wetted.

The thermometer is suspended from the rim of the glass cylinder by means of a bent wire hook in such a position that the thermometer bulb is midway between the top and bottom of the glass cylinder. The scale of the thermometer should be clearly visible through the side of the glass vessel, so that the temperature may be read off without removing the thermometer from its position.

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* A tin of this is supplied, but fresh quantities may be prepared by mixing three parts of powdered Potassium Chlorate and one part of powdered Potassium Nitrate (common Nitre). This mixture, which must be kept absolutely dry, supplies the oxygen required for the combustion of the coal, since, for the purpose of the test, the coal must be burnt out of contact with air.

The metal work and glass soon acquire the temperature of the water, but it is necessary to stir the latter by gently raising and lowering the metal apparatus until the thermometer gives a constant reading.

The metal apparatus is now removed from the water, the cylinder separated from the base, and the free extremity of the fuse ignited. The apparatus is then quickly put together again and re-immersed in the water.

In less than a minute a rapid flow of gas bubbles escape from the perforated base of the cylinder, showing that the charge has ignited. As these bubbles rise through the water a rapid interchange of heat takes place, the cold water being warmed, and the hot gasses cooled. As soon as the action quite ceases, the tap is opened so as to allow water to enter the apparatus, and become heated by contact with the hot metal cartridge.

The water is then once more thoroughly stirred by raising and lowering the metal apparatus, whilst the eyes are kept fixed on the thermometer. The mercury column will be seen to rise steadily, and as soon as it remains stationary the exact reading is noted down before the temperature commences to fall, owing to radiation of heat by the glass cylinder. Both the initial and final temperatures must be read off to a tenth of one degree.

The difference between the initial and final temperatures, multiplied by 1000, should give the Calorific value of the sample of coal tested, but a correction of one-tenth is added for the heat absorbed by the metal apparatus itself.

The following example will make this clear:—

		Degrees Centigrade.
Temperature of room	=	19·3
Temperature of water before combustion .	=	13·2
Temperature of water after combustion ..	=	20·3
Increase in temperature of water:—20·3—13·2	=	7·1
Heat absorbed by Calorimeter = $\frac{1}{10}$	=	·71
Corrected rises in temperature	=	7·81

7·81 × 1000 = 7810 Calories.

From this result we can calculate the evaporating power of the fuel; this being usually expressed as pounds of water (at the boiling point) converted into steam at the same temperature. This is done by dividing the total Calories by 537; and in our example we obtain $\frac{7810}{537}$ = 14·54 pounds of water evaporated per pound of coal, from and at 100° C. (212° F.)

Note.—To obtain correct results by this test it is of course assumed that the two grams of coal are completely burned, leaving only a small quantity of grey ash free from black particles. To make matters certain, the metal apparatus should be removed from the water and the latter allowed to stand undisturbed for some hours so that the suspended ash (and coal, if any), may settle to the bottom of the glass cylinder. On separating the metal cylinder and base, the cartridge will be found full of water which should be emptied into a clean test-tube, and the cartridge rinsed out with small additions of clean water, these rinsings being added to the test-tube which is then allowed to stand. The sediments left in the large glass cylinder, as also that in the test-tube should be examined after decanting off the bulk of the clear water. If dark in colour, some carbon in the two grams of coal will have escaped combustion and the result of the test will be slightly below the actual Calorific value. A correction for any unburned carbon is possible, but somewhat difficult to carry out, and it is therefore better to ensure complete combustion by taking the following precautions.

1. Dry about 30 grams of the oxygen mixture before weighing out the 26 grams used in the test. This may be done by exposing same in a thin layer to the air in a heated place.

2. The two grams of coal must be very finely divided and perfectly mixed with the 26 grams of oxygen mixture.

3. The metal cartridge must be absolutely dry, and the charge uniformly compressed.

It may be added that the Calorimeter described above is quite unsuitable for ascertaining the calorific value of megass.

Next in importance to the *quality* of the coal used comes the *quantity* required to make a ton of sugar. Even the stoking of the furnaces can be brought under chemical control by analysing the flue gases, but the methods are too refined to bear simplification. Considerable economy may, however, be effected by a judicious use of a "coal weigher" in distributing the fuel to the furnaces, and noting which stokers use the most coal.

In concluding this series of papers we may remark that the *practical utility* of the results obtained, when our simple method of chemical control are put into practice, will depend solely on the care and accuracy with which the tests are made. It is for this reason that such work is best undertaken by those to whom accuracy has become habitual by long practice. Yet, if we have succeeded in convincing our readers that the methods, themselves, are *practical* and therefore *reliable*, the main purpose of these papers will have been achieved.

SUPPLEMENTARY LIST OF APPARATUS (*See Chapter II.*).

	£	s.	d.
Two Test Mixers, on foot, with lip, 50cc., 100 divisions	0	2	0
Two cork rings, 2$\frac{3}{8}$ inches inner diam.	0	1	4
One set of Becker's aluminium weights:—5, 2, 2, 1 mg.	0	1	3
One normal quartz plate mounted in brass tube for adjusting Polariscope to read 100° Ventzke with table showing values from 10° to 35°C	1	10	0
One test tube stand, with 12 holes and draining pegs	0	3	0
Two dropping bottles, with slotted stopper, A.K. patent 100 cc. capacity	0	0	8
Two pipettes, 10 cc., with bulb at one end	0	0	6
One dozen glass rods, fused ends, 5 in. long, $\frac{3}{16}$ in. thick	0	0	4
Triangular file, 4 in. long	0	0	4
Two foolscap note books	0	1	0
Six glass-cloths, or dusters	0	2	0
	£2	2	5

THE SAMALKOTA SUGAR CANE FARM.

By C. A. BARBER, M.A.

(Botanist to the Government of Madras.)

In giving an account of the sugar cane work at Samalkota, it is advisable first to trace the origin of the farm. Upon the Government Botanist's arrival in this country in 1898, a serious disease of a somewhat obscure nature was found present in the fields. The number of acres under cane in the Godaveri Delta, one of the richest cane-growing areas in Madras, had greatly decreased, and the export trade of jaggery from the port of Cocanada had seriously declined and was threatened with extinction. Under these circumstances, the Government Botanist was early deputed to make an investigation of the disease. This was determined to be caused by a parasitic fungus, *Colletotrichum falcatum*, well known in Java and the West Indies.

During his inspection of the fields, he was led to form certain views regarding the spread of the disease at variance with those usually adopted, and as it was impossible to test the matter at issue in the ordinary ryots' cultivation, it was suggested that a few acres of land should be rented from the ryots and the disease studied on the spot. This proposal met with the approval of Government, and in April, 1902, five acres of land were planted with sugar cane, and placed in the Government Botanist's charge.

The conclusions arrived at before the establishment of the farm were as follows:—

(1) That the disease was an *internal* one, in the sense that it passed from generation to generation inside the plant. The rarity of spore-formation and the extremely scattered nature of the small sugar cane gardens in the district, together with the slow but steady spread of the disease, appeared to discount the idea prevalent in the West Indies, that the disease was chiefly spread by the wind.

(2) That where the disease was spread from plant to plant, it was mainly through infected soil, or by the water channels into which the rotten canes were usually thrown.

(3) That the surest way to induce the disease to make its appearance was to plant the canes in a water-logged site. That no cane could withstand the disease when constantly submerged or kept in swampy ground, as was the custom of the ryot.* That the ryot, in fact, had given way to careless cultivation because of his abundant water supply, and had treated the sugar cane in much the same way as he did paddy. Instead of incurring the labour of digging and aerating his land, he swamped it with water and worked it in puddle.

(4) It came to light, moreover, that it was no new thing for a favourite cane to be swept away by disease. Successive canes had held favour in the district during the past forty years, each in turn growing luxuriantly and bringing wealth, but after a few years becoming diseased and causing wide-spread loss. It was evident that bad cultivation was the cause of all this; the constitution of each cane had been broken in turn by the ever present fungus, until all the plants of that kind in the district were infected.

These beliefs have guided the work of the farm. The main object of the farm was obviously to resuscitate this dying industry, and the various experiments which have been tried during the three years of its existence have had this point in view. Fresh land has been rented from the ryot year by year, and the canes have, therefore, been planted in strictly normal conditions (after paddy in puddle), but all matters of drainage have been attended to with the most zealous care. The most careful scrutiny of the sets planted has been maintained year by year, and all with the faintest visible trace of disease rejected. The result has been, that in the freshly planted land, disease has decreased each year in the canes, the farm always being the most healthy garden of the neighbourhood.

The first canes planted were such local varieties as could be got together, to which were added five varieties kindly contributed by Mr. Mollison from Bombay. In the second year of the farm's existence attention was drawn to the presence of a small field of canes at Vizianagram (about a hundred miles north of the farm), which had been introduced from Mauritius four years previously, and which had been allowed to run wild. These were carefully gone over, and such varieties as seemed to be of merit, were introduced into the farm. In the third year various canes were added from different parts of the country, including the *Kajli* and *Samsara* of Bengal.

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* Native farmer.

The introduction of these new canes, and the collection, side by side with them, of the local indigenous varieties, resulted in the settled conviction that the whole of the local cane flora with its many varieties was permeated by disease, and that salvation was to be obtained by the discovery of immune varieties. The improvement of the ryot's cultivation is a matter beyond the scope of a few years' agricultural experiments.

It is noteworthy that in the main varietal plots, whereas in the first year nine local varieties were tested, these have now been reduced to three, all the rest having proved (generally speaking, in their ratoon growth) that they were hopelessly diseased. The work on the farm is now largely carried on with varieties new to the district.

The two main lines of work have become, firstly, the selection of hardy varieties of good sugar content and the distribution of these to the ryot; secondly, the discovery and even production of new forms to take the places of those already distributed and destroyed by the ryot's methods.

The farm was commenced under great difficulties. There were local troubles as regards labour during the first year and a half. There were no less than six changes of management in the same period. In each year the land had to be hastily acquired at a high rental and with insufficient time for preparation. On the other hand, the farm was extremely fortunate in the canes sent over by Mr. Mollison, for to one of these canes, as will be seen, it owes its present success. Its future power and usefulness is guaranteed by the unique case referred to above of that field of canes in Vizianagram, where some twenty kinds of Mauritius canes of good quality had been introduced four years previously, and allowed to fight it out under adverse conditions in a new country. Of the twenty canes introduced, about one-half have succumbed, two or three have practically monopolised the field, and sports and reversions have occurred abundantly.

It was noted early in the history of the farm that one of the varieties from Bombay, the *Red Mauritius*, showed good germinating power and healthy growth. It was analysed at the end of the first year and the juice was found to be fairly good. It is an axiom in cane improvement, that no cane should be distributed from an experimental farm, until it has been thoroughly examined and tested for a number of years. But the matter was urgent, and the previous good character of the *Red Mauritius* in Bombay was allowed to have weight. Accordingly, at the end of the first year, sufficient sets to plant one-tenth acre plots were distributed to two ryots, under binding conditions that if so directed, they should boil the whole into jaggery. The power was thus retained of withdrawing the cane from circulation if desired.

During the second year the *Red Mauritius* sustained its character both in the plant canes and in the ratoons on the farm. At the end of the second year it was widely advertised both in the village sheet of the *District Gazette* and in the local papers, as well as by emissaries sent through the villages with samples of the canes. About eighty applications were received. In its distribution it was sent to various parts of all the six taluks of the District. During the third year every one of the plots thus planted was twice inspected, the opportunity being taken for directing the ryots in their mode of cultivation. The result of this action was recently seen in widespread clamour for more seed. Hardly any *Red Mauritius* cane was made into jaggery, and far more applications were received than the farm could possibly satisfy, the seed changing hands in some cases at very high prices.

The first step towards the resuscitation of the industry has thus been successfully taken. A new cane, of good general character, has been placed before the ryot, and he has eagerly taken it up. But this work of distribution has merely been commenced, and though certain ryots, and even villages, have declared that they will adopt the farm methods of cultivation, the great bulk of the ryots have as yet been in this respect untouched. There is hardly a village where the new cane cannot be obtained, but it is being subjected to the ruinous and wasteful water-logging of the district. How long its constitution will stand the strain is doubtful.

But meanwhile, other canes are being pushed forward on the farm to take its place. After reviewing the inspection results of the *Red Mauritius* plots referred to above, one ryot in each taluk was selected, because of their intelligent attempt at following the farm practice, and to them have been entrusted two more canes, the *White Mauritius* and the *Striped Mauritius*, for experimental trial during the year, under the same binding agreements. These six ryots will be visited during the year, and the result of the inspections will be made use of in the next year's distribution. It may be noted that the *Striped Mauritius* appears to be superior to the *Red Mauritius* in every respect except tillering power. It germinates well, grows to a great height, gives a heavy out-turn, has very rich juice, and makes excellent jaggery.

Following this method, the farm is exerting itself more and more to produce a succession of good hardy canes. The *Ashy Mauritius* is probably slightly better than the *Striped Mauritius*, and all of them are apparently left behind by a new cane, a "sport" which has been analysed this year for the first time. These canes will have the advantage of a longer trial, and it is hoped that it will in time be possible, with certainty, to make a new cane available whenever it is desired. *Seedling canes* are not being neglected. Two varieties received from Barbados are now being acclimatized in an area apart from the farm. Fifty-two boxes of arrows have been put down during the last two years to obtain Indian seedlings. The results have not been satisfactery, as the fierce dry heat of the Coromandel Coast at the time of flowering is probably too much for the delicate germ. Two seedlings were obtained this year, but unfortunately succumbed after a few weeks' growth. It has been something, however, to determine that the ovary of the sugar cane is fertile in India.

Finally, an attempt is being made to raise resistant varieties of those canes which have gone under in the past. The principle of this is simple enough. Wherever in a patch of diseased canes one or two healthy shoots are seen, these are marked and later carried as seed to the "disease plot." Here the soil is purposely infected, rejected diseased cuttings are planted, and the plot is badly treated generally. The introduced stools mostly go under, but by repeating the process it is hoped that a more hardy strain may ultimately be obtained. The degenerate local kinds have some of them an excellent parentage, and there is no reason why, in time, success may not attend this mode of procedure.

Samalkota farm is purely local. It was started for the definite purpose of throwing fresh blood into the local cultivation. Incidentally, it will perform other functions. The ten best varieties have been sent down to South Arcot to form a new farm there, and the *Red Mauritius* and some other canes are already appearing in various parts of the country.

But besides this question of distribution, advantage has been taken of its existence thoroughly to study cane cultivation and jaggery production from every point of view. The results of these inquiries cannot be dealt with in the present paper.

It has now been decided that the farm shall be made permanent, and thirty-six acres of land are being acquired for the purpose. This land, which is in a very rough condition, is being got into order, and permanent buildings are being erected. It may be possible on a future occasion to give some account of the various experiments being carried out on the farm.—(*Agricultural Journal of India.*)

The 1905 sugar cane crop in Madeira was larger than that of 1904, and a greater proportion of the cane was utilised in the manufacture of sugar. Little or no sign of disease was observed.

ROOT DISEASE OF THE SUGAR CANE IN HAWAII.

Mr. L. Lewton-Brain, Assistant Director of Pathology and Physiology to the Hawaiian Sugar Planters' Experimental Station, has lately issued some preliminary notes on root disease of sugar canes in Hawaii, with several illustrations, one of which we reproduce on another page. His results are summarized below.

Root disease is the most important fungoid disease of sugar cane in the Hawaiian Islands. It is responsible for the abandonment of Lahaina and Rose Bamboo canes in certain localities. Its most marked effects are seen on ratoons.

The first symptoms of root disease are like those of drought. The leaves stand upright, roll up, turn yellow, and gradually become very dry; the leaf-system is much reduced. The lower leaf-sheaths become matted together, and to the base of the stem. A white fungus mycelium is found among them. In Hawaii, root disease is also noticed to affect germination.

The root fungus attacks the growing point of roots, so preventing their further development. As this continues, the water supply from the soil is reduced; this brings about secondary effects on nutrition, which react again upon root development. Finally, the nutrition of the cane suffers severely.

The sugar cane, growing naturally, possesses considerable powers of resistance to root fungus, and is able to outgrow an attack.

Root fungus is essentially a soil fungus. It is able to live as a saprophyte on dead organic matter in the soil, and especially about the bases of the cane stools.

Treatment for root disease consists in, first, planting resistant varieties, as the Yellow Caledonia, the utmost care being taken to secure healthy seed. Cultivation and liming the soil tend to destroy the fungus there, and are also favourable to the vigorous development of cane roots. Ratooning is, generally, not advisable. The destruction of diseased material should be as thorough as is consistent with economy. It is sometimes necessary to throw land out of cane cultivation on account of this disease; a remunerative rotation crop would be of great value here.

The full details can be found in Bulletin No. 2 (Division of Pathology and Physiology) of the Experiment Station's Publications.

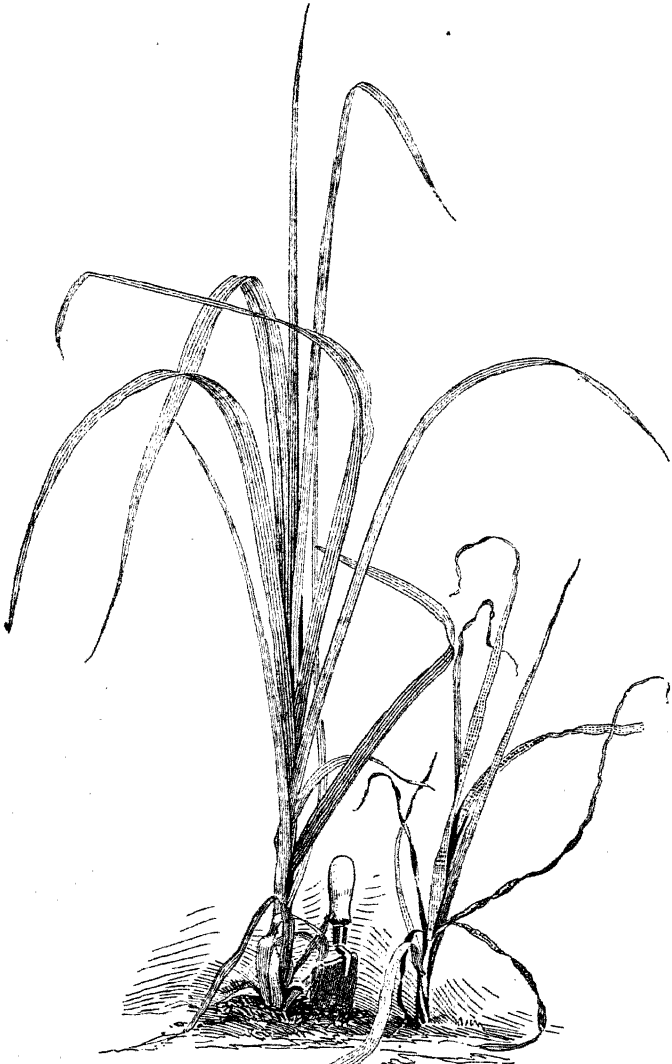

Fig. 1. Two canes, from different stools, to show the effect of root disease on growth, from a photograph. These canes are of the same variety, and were taken from the same row, so that they were grown under identical conditions; they were between three and four months old. The cane on the right (B) is badly attacked by root disease, while that on the left (A) is only slightly attacked. (It was impossible to find a perfectly healthy cane for comparison.)

INTERNATIONAL COMMISSION FOR UNIFORM METHODS OF SUGAR ANALYSIS, 1906.*

Conclusions regarding the method to be recommended for Estimating the Percentage of Sugar in the Beet.

By H. Pellet.

Gentlemen, you have done me the honour to nominate me one of the contributors to the present question; before beginning my paper I would tender my thanks for your courtesy. You will not expect from me a very long paper as, so far, the question we are mutually considering has already proved the subject of countless contributions on the part of a large number of experts engaged in the sugar industry in every country. Permit me, however, to recapitulate the dates of the different alcoholic or aqueous methods of extraction brought forward for the purpose of estimating sugar.

Alcoholic Methods.

It was in 1747 that Margraff first made use of alcohol to determine the presence of crystallizable sugar in various plants, the beet in particular.

In 1825 Dubrunfaut likewise made mention in his splendid work entitled "The Art of Beet Sugar Manufacture," of the use of alcohol for extracting all the sugar from the beet and even for ascertaining the proportion of sugar in the beet by the complete crystallization of such alcoholic extracts.

E. Peligot in 1839 pointed out a method of estimating the sugar in the beet by means of evaporating an alcoholic extract and weighing the dry residue, regarding this as nearly pure sugar.

In a study on the manufacture of beet sugar in Ireland, mention was made of a process for extracting the sugar by means of alcohol in order to estimate the percentage of sugar. But for want of the saccharimeter, it was consequently but a slight improvement on the process of Margraff in 1747.

In 1874 M. Ed. Riffard proposed the estimation of sugar in beets by means of alcoholic extraction in a Payen's "digester." The alcoholic extract containing all the sugar together with some impurities was examined in a saccharimeter.

In the French translation of Walkhoff's treatise, published in January, 1874, reference was made to a process for estimating the sugar in the press-pulp, and which was also applicable in the case of the original beets. This method was utilised by Messrs. P. Champion and Pellet about the same period, and was described by these gentlemen in a paper on chemical control published the same year. The method had been in use during the 1873 campaign.

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*Read to the Members of the International Commission for Uniform Methods of Sugar Analysis at its Session, August, 1906.

It was on May 2, 1878, that Scheibler took out a patent for a process of extracting sugar, and for an apparatus for the extraction of substances in general. His principal contribution on the subject appeared in January, 1879, in *Scheiblersche Neue Zeitschrift, No.* 1. It is given as follows:—

"Apparatus and process for the separation and estimation of sugar contained in vegetable substances (sugar, beet, cane, etc.) and in similar materials, and in general, for the separation of soluble from insoluble substances."

From this time onwards a multitude of processes based on extraction with alcohol made their appearance. Among the best known we may mention that of Stammer, in which hot or cold alcohol was used according to the fineness of the pulp; that of Degener, of Sostmann, of Rapp-Degener, etc. But we cannot refer to them all.

METHODS EMPLOYING COLD WATER.

Among the processes employing water as a solvent for extracting sugar we may mention: First, the Pelouze process, in which the whole of the sugar is extracted from the beet pulps, allowed to ferment, and the sugar then estimated from the quantity of alcohol produced (1831-32). In Barreswill's process, 1844, the crystallizable sugar was extracted from the beet, inverted, and the invert sugar estimated by the copper test. It was not until 1848 that the saccharimeter came into use for the determination of sugar, due to the labours of Biot, Mischerlich, Soleil, and Clerget. This led to the appearance of several new processes, but Violette, in 1868, published a pamphlet on the estimation of sugar in the beet by means of copper solution.

The next to make its appearance was the Commerson process in 1868, which was an aqueous extraction with polarization and inversion after Clerget. Our distinguished colleague, M. Vivien, published in 1873 (*Sucrerie Indigène,* September 5) an article on the analysis of juices and sacchariferous plants in which was described his direct method of estimating sugar in the beet by crushing up the latter with sand and washing the pulp thus formed with hot water. In 1874, Messrs. Champion and Pellet designed a process for estimating sugar in the beet, which was in use for some time in sucreries. It is based on heating the pulped beet with a certain quantity of water. Knowing the weight of the pulp taken, of the water added, as also of the water in the pulp, the amount of sugar in the liquid separated by a press could then be calculated from the saccharimetric readings. The somewhat similar process of Barbet-Durin appeared in 1879.

In 1883 H. Pellet described a form of hot aqueous digestion in special flasks. In 1885 M. Sachs published his method of estimating sugar in beets by means of two tests; the one on the juice extracted, the other on the residual pulp.

In 1886 M. Van Niessen proposed to substitute water for the alcohol in the Stammer process, but advised the setting aside of the liquid for 10 or 12 hours previous to polarizing. The same year S. Poliakowsky referred to a process for estimating sugar in beets, which might have suggested the utility of hot water digestion. His process likewise required two polarizations.

METHODS EMPLOYING HOT WATER.

It was therefore only in 1887 that the process of hot water digestion was established on a practical scale, thanks to the numerous contributions to the subject; and it was first adopted at the Wanze Sucrerie during the 1887-88 campaign to estimate the sugar content of all the different beets bought by the factory. The total number of analyses made in the various laboratories of this usine rose to more than 50,000.

INSTANTANEOUS COLD DIFFUSION.

But the process of hot water diffusion was superseded during the 1888-89 campaign by the process which I have termed *Instantaneous Cold Diffusion*, and which I have ever since adopted. Its use has spread extensively, especially in Belgium and Holland, and it has been equally applied to the selection of beet-mothers in a great number of laboratories in various sugar countries. Since their appearance, the method of extraction by means of hot and cold water has been keenly criticised by some, and recognised as accurate by others.

We need not recapitulate the criticisms which have been directed against the aqueous method of extraction, nor the advantages which have been ascribed to the alcoholic processes. The critics of the aqueous method are gradually finding out the errors inherent in the alcoholic process and are declaring that the aqueous extraction alone should be employed. I need not mention names, as they are well known.

It is well that the supporters of the aqueous method are becoming more numerous, and those of the alcoholic method less. The discussion has gone on for the last ten years and at the 3rd International Congress of Applied Chemistry, at Vienna, the aqueous process was declared the right one by a certain number of our foreign colleagues and discussions ceased from that time. Nevertheless from 1898 to 1900 articles appeared from time to time on the aqueous and the alcoholic methods, and in some of them the differences between the two were given. But the differences instead of being 3%, 2%, 1% or even 0·70% were only from 0·20 to 0·30%. However it is certain that estimations of sugar are still made by the alcoholic (digestion) method which give results 1 or 2% below the truth, leading one to believe that by means of a special process of liming the fresh beets, a loss of from 1·25 to 1·47% of sugar can be avoided, when this difference, according to several authorities, is solely due to an error in the analysis.

Apart from that, I can affirm that two years ago in certain factories in Germany results were obtained by alcoholic digestion which were from 0·60 to 2·50% below the actual. Here is an instance:—

Sugar % of the beet slices	14·7	16·00
Juice of fresh slices % gr.	18·7	18·1
Purity	89·0	88·7

The analysis of the juice of the beet slices shows the beets to be almost similar. In spite of that, however, there is an error of 1·3% in the sugar % of the beets.

Calculating on a basis of 90% of juice in the beet, we obtain:—

Sugar	17·2	16·6
Difference	2·5	0·6

The average error is, therefore, about 1·55. If then in this above-mentioned usine they had adopted the said process they would have claimed an advantage of 1·5% solely due to a mistake in the estimation of sugar in the beet slices. I may mention that one of our most distinguished colleagues in Bohemia has informed me recently that the estimation of sugar in the beet by alcoholic digestion may give results from 0·5 to 2% lower than those obtained by aqueous extraction.

We have then complete accord in the results between the hot and cold aqueous methods and the method of alcoholic extraction, and we realize the errors due to the method of alcoholic digestion.

It can be said to-day that chemists of various countries obtain identical results when ascertaining the sugar in the beet pulp by

1. The hot water method.
2. The cold water method.
3. The alcoholic extraction.
4. The alcoholic digestion.

Again, all have mentioned the difficulties occurring in the alcoholic extraction method, and, furthermore, these chemists have shown that the results obtained by alcoholic digestion are often inaccurate. The defenders of the alcoholic extraction and, still more, of alcoholic digestion, are getting fewer and fewer in number, and if to-day these methods are still employed in certain laboratories, it is rather owing to habit, or perhaps even on account of the actual defect. For what M. Sachs said in 1896 is always true. "What accounts for the preference given to the alcoholic method in Germany? Simply the fact that it is easy by this method to find a half per cent. of sugar less than if one made an accurate test."

Let us now see what are the inconveniences met with in using the alcoholic methods.

1. With alcoholic digestion, the complete extraction of the sugar is difficult, if not always impossible; especially when the alcohol used is somewhat concentrated.

2. An excess of sub-acetate of lead precipitates some of the sugar.

3. One cannot be certain of complete extraction save by making several tests, heating for different periods, and by promoting the solution of the sugar by agitation.

4. Alcoholic extraction occupies a comparatively long time, varying from half an hour to four hours, according to the fineness of the pulp and the apparatus employed. Moreover one can only be certain of complete exhaustion of the pulp by successive extractions. And here again the excess of sub-acetate of lead has the same inconvenient results as with the alcoholic digestion.

5. Alcoholic liquids present difficulties in polarization on account of their sensitiveness to changes of temperature.

6. Alcoholic liquids are volatile.

7. The alcohol required to make a large number of analyses is considerable, and

8. The process is a costly one, both as regards the alcohol used, and on account of the large staff required to carry on the series of analyses necessary for controlling the prices paid for beets at the factory.

Let us now turn to the advantages of our methods of hot or cold aqueous extraction.

1. They are easy, simple, rapid, and inexpensive.

2. They require less material and attention on a large scale.

3. They give accurate results, provided that sufficient sub-acetate of lead is used for clarification.

4. An excess of sub-acetate is not objectionable.

In the hot aqueous method, the duration of the heating generally adopted always ensures complete digestion.

6. In the instantaneous cold diffusion accurate results are immediately obtained without any length of contact being required.

7. The aqueous liquids polarize very easily and permit the employment of a "continuous" observation tube which is almost impossible in the case of alcoholic liquids.

The aqueous methods may be roughly divided into extraction processes and those involving digestion or diffusion.

Extraction Processes :—

1. Delville's method of hot extraction.
2. Vivien's hot water extraction.
3. Zamaron's hot extraction.
4. Pellet's hot extraction.
5. Pellet's methods of cold extraction

Digestion and Diffusion Processes:—

1. Pellet's methods of hot digestion.
2. Pellet's instantaneous cold diffusion.

We have not made any mention of processes which admit the use of hot water with prolonged digestion, for, as we have said, the pulps can only be classified as (*a*) those which can, and (*b*) those which cannot, be analysed.

PELLET'S INSTANTANEOUS COLD DIFFUSION FOR THE DIRECT ESTIMATION OF SUGAR IN THE BEETS, FRESH AND EXHAUSTED SLICES, AND FOR THE SELECTION OF BEET-MOTHERS.

For some time one has been obliged to employ

1. The hot water digestion for the direct estimation of sugar in fresh beet slices, the known machines for preparing the pulp being more or less practical.

2. The instantaneous cold diffusion has long been employed for the analysis of whole beetroots and for the selection of beet-mothers by means of special machines producing pulp, which can be analysed by our instantaneous diffusion method. But to-day, thanks to the apparatus of Messrs. Mastain and Delfosse, known as the "Sans Pareille" press, it is easy to obtain pulp which can be analysed by the instantaneous cold diffusion, either from fresh slices or from pieces of beetroot of any shape.

It amounts to this, that the beet, whatever be its method of division, can be analysed by a single process, that of Pellet's instantaneous cold diffusion.

To give details: 1. In the case of whole beets it suffices to prepare the pulp by means of a special cutting disc known as the Keil cutter (similar to a wood rasp file). We may remark incidentally that only the conical rasper of Messrs. Pellet & Lamond permits the taking of an accurate sample from a lot of beets. The numerous rasping plates of a more or less conical form employed in some laboratories, especially in Austria, do not supply an accurate mean sample.

2. With fresh beet slices, a portion representing a mean sample should first of all be passed through a mincing machine so as to convert it into a coarse pulp, then a portion of this pulp is put through a Sans Pareille press, so as to convert it into a fine pulp suitable for analysis. One might also pass a sufficient quantity of fresh slices direct through this press and so obtain the required pulp more expeditiously.

3. The pieces of beet removed from certain parts of the roots can be treated in the same manner, being passed through a mincing machine, and then through a Sans Pareille press.

Provided we are certain that the pulp so obtained can be analysed by the cold method, the process is simple enough. A given weight of pulp is taken, and to it is added the required volume of sub-acetate of lead, the volume being diluted to 200 cc., after the foam has subsided. The whole is then mixed, filtered immediately, and polarized. The test should be repeated with the same pulp, letting it diffuse on a water-bath at 80° to 85°C for a quarter of an hour only, cool, etc., and then observe if there is any difference.

Instead of heating on a water-bath, boiling water may be added to the pulp, the mixture being cooled previous to filling up to 200 cc. (This is the method advocated by Herles, but it offers no special advantages in routine work, it being better to prepare the pulp for cold extraction.)

In the case of the hot water method, the period of heating is the only point of interest. It is known that one hour's heating on a water-bath at from 75° to 80° is always sufficient for complete digestion, when the pulp has been passed through the mincing machine so as to render it uniform* and the coarse pieces carefully removed. It is equally proved that the time of digestion can be reduced by first bringing the water-bath up to the boiling point, as also by washing the weighed pulp into the flask with boiling water. But we fail to see any reason for continuing with the hot water digestion when we possess an instantaneous cold process applicable in every case.

We think we ought to warn our colleagues against employing any press in imitation of the "Sans Pareille," save on the express condition that the pulp obtained from it can be analysed in the cold without contact for any length of time. For when one cannot be sure of results and differences exist, one may attribute them to the method, when it is entirely due to defective apparatus which in this case at least, claims to produce pulp similar to that from the "Sans Pareille" press of Mastlain and Delfosse. This said, let us explain how the direct estimation of sugar in the beet can be carried out by Pellet's instantaneous cold diffusion.

1. Weigh out a portion of pulp corresponding to the normal weights of the saccharimeter in use, *i.e.*, 16·29†, 20, or 26 gr.‡

2. Rinse this pulp into a 200cc. flask with cold water.

3. Add a quantity of lead sub-acetate representing 30% of the weight of the pulp.§ The sub-acetate should have a density of 30° Baumé, and be prepared according to the directions given by Codex or by those of Courtonne (25° Baumé).

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* It is evident that if the pulp contains large pieces of beet which have escaped the action of the rasp, one cannot mention any time as the period for the heating.

† Double the normal weight of 16·29 should be taken.

‡ This slightly modified weight avoids a correction for volume of the marc, as explained below.

§ The quantity needed is much less but an excess of this re-agent does not matter. Besides, ordinary water neutralizes a considerable part of the lead.

4. Dilute with water nearly to the 200cc. mark, remove any foam by adding a few drops of ether or a mixture of ether and alcohol.

5. Complete the volume to 200cc., shake vigorously, and filter. To the filtered liquid add a drop of glacial acetic acid. Polarize in an ordinary 400mm. tube or in a "continuous" tube of that length. The reading will then give the saccharine richness of the pulp analysed.

A few remarks may be made here.

1. If more than 26 gr. of the pulp are taken per 200cc., there may be some difficulty in getting rid of the foam, though not an insurmountable one.

2. When using the Keil or Dolle rasping discs, which revolve at somewhat too high a speed, the sample is sometimes too much emulsified and, consequently, the foam is more abundant.

3. With discs of ordinary dimensions, the speed should not exceed 175 to 200 revolutions per minute. Certain discs are made to run at 1,000 or even 1,500 revolutions per minute.

4. A pulp suitable for rapid analysis in the cold need not be reduced to what was formerly described as "cream," so long as the state of division is sufficiently fine and regular.

By fulfilling these conditions, accurate results can be rapidly obtained.

We must now turn our attention to the influence of the marc on the final volume of the solution; or to the modification of the weight of pulp taken to give correct results when diluted to 200cc. The marc of the beet, being insoluble, occupies a certain volume, so that if the normal weight be taken it is necessary to dilute to more than 200cc. If, on the other hand, a volume of 200cc. is adopted, this must contain somewhat less than the normal weight of pulp. In this connection we have repeated the calculations based on the following data:—Mean percentage of marc in the beet, 4·8; density of marc (Tollens, Pellet, &c.) 1·6; volume occupied by the marc, 3cc. At first we thought it necessary to take into account the small quantity of lead precipitate formed, but after numerous experiments, of which an account will be given in another paper, we found that this could be ignored.

We have therefore drawn up the following table, giving the weights required to give a true volume of 200cc., or the final volume to which the solution should be diluted when the normal weights, or multiples of same, are taken for analysis:—

WEIGHTS OF PULP TO BE DILUTED TO 200 C.C.

FRENCH SACCHARIMETER. Normal weight = 16·29.			SACCHARIMETER. Normal weight = 20 gr.			GERMAN SACCHARIMETER. Normal weight = 26 gr.		
Weight of Pulp. Grams.	Sub-acetate of lead. cc.	Volume occupied by the Marc. cc.	Weight of Pulp. Grams.	Sub-acetate of lead. cc.	Volume occupied by the Marc. cc.	Weight of Pulp. Grams.	Sub-acetate of lead. cc.	Volume occupied by the Marc. cc.
32·42	9	0·98	19·94	6	0·60	25·89	8	0·78
16·25	5	0·49	9·98	4	0·30	12·97	5	0·39
8·13	3	0·24	4·99	3	0·15	6·49	3	0·19

VOLUMES TO WHICH THE NORMAL WEIGHTS, AND THEIR MULTIPLES, SHOULD BE DILUTED.

FRENCH SACCHARIMETER. Normal weight = 16·29. cc.	FRENCH SACCHARIMETER. Normal weight = 20 gr. cc.	GERMAN SACCHARIMETER. Normal weight = 26 gr. cc.
201	200·6	200·8
200·5	200·3	200·4
200·25	200·2	200·2

SOME NOTES ON MODIFICATIONS WHICH HAVE BEEN MADE IN PELLET'S PROCESS FOR THE DIRECT ESTIMATION OF SUGAR IN THE BEET.

One modification of my process consists in omitting the final adjustment of the volume by adding to a known weight of pulp certain pre-arranged volumes of water and reagents, the whole being then mixed, filtered, and polarized.

It is hard to say who was the originator of this modification, although it is now agreed that Loewenberg first drew attention to it in 1892 with the idea of avoiding the inconvenience due to the formation of foam. At this date, or even later, the presence of air, in quantities wholly unexpected, was shown to be a fact. Admitting this to be the case, it proves either that the ratio of pulp to the total volume was excessive (26 gr. per 100cc. being often taken), or that the pulp was prepared by a rasping disc, the speed of which exceeded 1,000 (possibly even 1,500) revolutions per minute, as we have ourselves seen, and as was pointed out in the report of Maerker in 1889.

Although we have repeatedly called attention to the causes of error in the aqueous and alcoholic methods of extraction, operators constantly find themselves in difficulties by ignoring our instructions. It will suffice to recollect the number of articles published on this subject and my letters sent to the President of the Society of German sugar fabricants asking him to have experiments undertaken before a commission and thereby to obtain an experimental demonstration of the accuracy of my processes. I thus hope it may be possible to get these methods accepted, and to put a stop to the more or less violent controversy between the advocates of the aqueous method of extraction and their opponents.

As regards the processes based on the modification introduced by Loewenberg, I have stated many a time that the analysis of pulp, properly prepared in accordance with all my directions, presents no difficulty. Nevertheless this modification has been applied in several countries, for the analysis of beets and various types of apparatus have been constructed for rapidly measuring off the volume of water and of the reagent to be added to the weighed portion of pulp.

This modified process is based on a mean density of the juice of 1·075 to 1·080 according to the authors, and is generally given as under:—

Weight of pulp, 26·048 gr.; water added, 177 cc.; corresponding to a total volume of 200 cc. of liquid.

Numerous experiments have shown that the results are almost identical with those obtained by our own method, and, in practice, this is quite sufficient.

Only I would point out that this method might give results slightly different in cases where the beets analysed have a juice density appreciably different to that taken for the base; but, when anticipated, this may easily be corrected for.

Finally, I would state that my instantaneous method of cold diffusion is applicable to the analysis of exhausted pulp. In this case, the pulp is passed through the Sans Pareille press and twice the normal weight diluted to 200 cc., after having added the necessary sub-acetate of lead. The mixed solution is filtered and polarized in a 400 mm. (or, better still, in a 600 mm.) tube. One thus obtains the true percentage of sugar. It is unnecessary to correct for the volume occupied by the marc in this case.

One frequently finds 0·05 to 0·25 more sugar in the pulp as compared with indirect analysis of the juice obtained from the slices passed through a mincer and pressed.

After you have considered this question, gentlemen, I trust it will be possible to submit a proposition to the International Commission for Uniform Methods of Sugar Analysis, expressing the firm hope that it will approve of the same, inasmuch as it has for its sole object the unification of the method of estimating sugar, and may thereby put an end to discussions relative to such estimations. Moreover, this proposition has already received the unanimous assent of members present at the 5th Section of the 6th International Congress of Applied Chemistry at Rome last Spring. Likewise at the meeting of the 1st *Congrès de Chimie et de Technique Sucrières* at Liège, all the members present were disposed to accept such a proposition, but desired first to await the decision of the Rome Congress; and this last, in view of the coming meeting of the International Commission for Uniform Methods of Sugar Analysis, expressed the desire that this question should be submitted finally to your judgment. The propositions are as follows:—

1. The only practical method for the direct estimation of sugar in the beet is the hot or cold aqueous extraction, and in accordance with the principles established by Pellet, whatever modifications in detail may be made in the process.
2. That the method of alcoholic digestion should be entirely suppressed.
3. That the alcoholic extraction method should only be used in special cases, and should then be controlled as far as possible by the hot or cold aqueous methods, and be subject to all the necessary precautions for obtaining accurate results by this delicate process.
4. That in all analyses of beets, made with the object of ascertaining the increase of sugar during vegetation, the aqueous method alone shall be used in every country.
5. Only the hot or cold aqueous methods shall be used in the determination of sugar in roots, fresh slices, exhausted slices, etc., these being prepared for analysis by such well known apparatus as the "Sans Pareille" Press, or others capable of producing a suitable pulp for analysis by Pellet's method.

H. PELLET.

PREPARATION OF FEHLING'S SOLUTION. ESTIMATION OF REDUCING SUBSTANCES IN SUGARS AND THE DIFFERENT PRODUCTS OF THE SUCRERIE.*

By H. PELLET.

For estimating reducing sugars in the products of the sucrerie, more than 60 different formulæ have been proposed for preparing the copper solution. After having ourselves tried several of these and made a large number of comparative tests, we found Violette's formula (1868) the most convenient. We attribute its superiority to the fact that it contains a larger proportion of potash than Fehling's original formula. This greatly facilitates the regularity of the reaction and the production of the normal cuprous oxide, and also allows the mixed solution to be kept for some time, even for several months, without any deposition of red cuprous oxide, or alteration in strength.

Moreover, when the proportion of reducing sugars to organic non-sugars is small, the reaction is always sharp, whilst with Fehling's solution it is sometimes difficult to obtain complete reduction; also, when this end "point" is determined by decoloration alone, indefinite and troublesome tints are obtained when using Fehling's solution.

The following is the composition of Violette's solution:—

No. 1.

Sulphate of Copper (pure crystallized) ..	36·46 gr.
Distilled Water	146 cc.

Dissolve hot and cool before adjusting the volume.

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*Read to the Members of the International Commission for Uniform Methods of Sugar Analysis at its Session, August, 1906.]

No. 2.

Rochelle Salt.	200 gr.
Soda-lye of 24° Beaumé	500 cc.

Dissolve and cool before adjusting the volume.

Pour No. 2 solution into a litre flask and add No. 1 with constant stirring. Dilute the mixture to 1000 cc. at the ordinary temperature. When thus prepared, 10 cc. of this liquid will exactly correspond to 0·050 gr. of crystallizable sugar.

It is only necessary to replace the 36·46 gr. of copper sulphate by 34·64 gr. to have 10 cc. = 0·050 gr. of invert sugar.

The following is the same formula adapted for the preparation as two separate liquids:—

No. 1.

Sulphate of Copper Solution	34·64 gr.
Water to dilute to..	500 cc.

No. 2.

Rochelle Salt	200 gr.
Caustic Soda	130 gr.
Water to dilute to	500 cc.

For use, mix equal volumes, when 10 cc. = 0·050 gr. of invert sugar.

To determine the reducing sugars by means of the above solution we proceed as follows:—

1. When the solutions to be tested are not too highly coloured* and of convenient strength, we determine the reducing sugars directly by decoloration of the liquid under the usual conditions, employing the tubes recommended by Violette which are approximately 20 mm. in diameter and 20 to 22 centimetres long.†

One proceeds by measuring out 2 cc., 5 cc., or 10 cc., of Violette's solution to which is added the liquid to be tested; the mixture being boiled for a moment after each addition of sugar solution. These additions are continued until decoloration is complete. The end point is easily ascertained with a little practice, even by artificial light, for when too much sugar solution has been added the liquid assumes a yellow tint.

We have tried the different reagents proposed for ascertaining when the reduction is complete, but consider that they offer no real advantages, and sometimes may even introduce errors.

The copper solution is, of course, standardized against a solution of invert sugar prepared by approved methods, of which 10 cc. = 0·050 gr. of invert sugar; and we may here remark that we have always recommended the addition of from 0·3 to 0·5% of salicylic acid to this invert solution for the purpose of preserving the same, as without such addition it generally grows mouldy after some weeks' keeping.

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* The solutions must not be clarified with sub-acetate of lead but with the neutral acetate.

† We have had these tubes made of special glass.

2. When testing products containing only small percentages of reducing sugars, and of which 10, 12 or 15 cc. are required per 1 or 2·5 cc. of copper solution, a control test is made with this standard invert sugar solution diluted to the same extent, *i.e.*, 1 cc. or 2·5 cc. of copper solution are taken, and the invert sugar solution diluted 5 or 10 times. That this precaution is necessary was recognised by Messrs. Baird and Pellet some years age, and has since been confirmed by Soxhlet.

ESTIMATION OF REDUCING SUBSTANCES IN COLOURED PRODUCTS.

In the case of products which cannot be sufficiently decolourised by neutral acetate of lead, the reducing sugars are estimated by weighing the cuprous oxide obtained after this has been converted into black oxide of copper or into metallic copper by reduction with hydrogen.

This reduction may be effected in various ways, but the following method has been adopted by us for nearly six years, and always given complete satisfaction. If the material tested contains a relatively high percentage of reducing substance, it is diluted so as to reduce this to from 5 to 10 grammes per litre of solution.

The solution is simply filtered after being treated with a small quantity of sodium carbonate to eliminate any possible excess of lime salts and suspended matters.

40 cc. of copper solution are transferred to a lipped beaker of special glass (capacity 125 cc.), to it are added 10 or 20 cc. of the liquid to be analysed, diluted as stated above. The beaker is immersed in a water bath so that the level of the boiling water is a little above the level of the contents of the beaker. The heating is continued until a thermometer (immersed in the liquid) registers 85° to 88°C, and for three minutes beyond this point. 50 cc. of distilled water are added to the hot liquid, the whole stirred and then left to stand so that cuprous oxide may settle.

The whole is poured on to an ash-free filter 9 or 11 centimetres in diameter which has been moistened with distilled water, and the precipitate washed with hot water till the filtrate does not sensibly affect neutral litmus paper. Ignite the filter in an ordinary muffle furnace, and weigh. Subtract 3 to 7 mg. for the salts absorbed by the paper and multiply the weight of oxide of copper obtained by the factor—0·454 whereby the reducing matters present are estimated as invert sugar.

In order to determine how much should be deducted for the absorption of salts by the filter, it suffices to dilute 40 cc. of the copper solution with 60 cc. of hot distilled water and to pass this through a similar filter, previously moistened with distilled water. After washing, igniting, etc., one generally obtains from 4 to 6 mg. of ash from a filter of 9 cm. diameter. This correction can be ascertained once for all, providing the same quality of filter is always used.

In practice we believe that the direct ignition in a muffle furnace is much simpler than reduction by hydrogen, but this ignition must be carried out in an oxidising atmosphere. This condition is fulfilled in the case of a muffle furnace heated by gas or electric current. But furnaces heated by alcohol are defective, there being a partial reduction of the black cupric oxide formed or else incomplete oxidation even after treatment with nitric acid.

Similarly, ignition over a gas flame is unsatisfactory, as part of the flame has a reducing action.

In order to obtain the black oxide of copper, of definite composition, without the use of a furnace, a few drops of nitric acid are added to the ignited filter paper, by means of which the cuprous oxide is converted into cupric nitrate. The liquid is evaporated in a platinum dish and ignited to a red heat; only the lower portion of the dish being in contact with the gas flame thus avoiding any reducing action due to the flame. This is easily accomplished by supporting the dish on a copper plate having a circular aperture.

For routine analyses the factor 0·454 should be adopted. For analyses which demand special exactitude we determine this factor by the method shortly to be described, using about 20 cc. of the standard solution of invert sugar, and 40 cc. copper solution, so as to obtain from 0·180 to 0·250 gr. of ignited precipitate, the tests being also made in duplicate.

When the solution to be tested contains very little reducing substances, for example those prepared from white or other high-grade sugars, the reduction is carried out on 5 or 10 grammes of the sugar, adding thereto 40 cc. of copper solution, and bringing the total volume to 60 cc., so as to maintain the conditions constant. Finally in order to reduce the cost of the copper solution, routine analyses may always be carried out with half the quantities mentioned; namely 20 cc. of copper solution, 20 cc. of the liquid to be analysed (or 5 or 10 cc. of liquid to be tested plus water to make up the total to 40 cc.) treated as directed above.

In the case of beet sugars or white cane sugars we carry out the estimation in the same way, but dissolve at least 10 or 20 gr. of the sugar in a total volume of 20 or 40 cc. to 20 cc. of copper solution, we then add 20 cc. of the said sugar solution so as to obtain 40 cc. of the heated mixture, continuing as before.

The use of the water bath for effecting the reduction offers many advantages over direct boiling, including :—

1. From three to ten operations can be easily attended to without causing any delay.

2. The heating is very regular.

3. The reduction is complete.

4. The action of secondary products and even of crystallizable sugar on the copper solution is avoided.

When boiling is resorted to, it is known that the reducing sugars cannot be estimated if the weight of copper oxide does not exceed 50 mg. per 100 gr. of sucrose present; but by following our instructions, no appreciable precipitate is obtained with absolutely pure sugar.

Besides, we have assured ourselves by numerous experiments that, under the conditions stated, heating to 85°—88° is sufficient to obtain a reduction of the copper solution by any products capable of such reduction. We have found, for instance, that in the case of invert sugar a temperature of only 75° is sufficient for complete reduction.

As a result of many experiments during the last ten years in our different cane and beet sugar laboratories, we have proved that this method gives very accurate results. It will be seen that we have dispensed entirely with the use of sub-acetate of lead when estimating reducing substances* in saccharine solutions.

We, therefore, request the International Commission for Uniform Methods of Sugar Analysis to consider the following proposal which we have the honour to submit to them:—

A certain number of flasks containing average samples of cane molasses, and of ordinary cane sugar to be prepared, and a flask of each sent to the members of the International Commission for Uniform Methods of Sugar Analysis with the request that the reducing substances be estimated

(i.) By Herzfeld's method;

(ii.) By the method we propose;

(iii.) By any given method which they have already made use of.

The results to be sent under sealed cover to Prof. Herzfeld, and a commission of at least three members to be nominated as judges, in addition to a reporter. We will voluntarily undertake the preparation of these samples and have them forwarded to the members of the Commission.

About 85 % of the refined sugar exported from Mexico finds its way to the United Kingdom.

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* Opinion is besides unanimous in cane sugar factories in avoiding the employment of this agent under these conditions, and numerous works on the subject issued since 1874 refer to the precipitation of levulose by sub-acetate of lead.

THE STATUS OF THE BRAZILIAN SUGAR INDUSTRY.*

METHODS OF MANUFACTURE.

Before proceeding to the consideration of the relevant information as regards the existence or non-existence of a direct or indirect bounty in Brazil, it will be well to give a short account of the methods of manufacture in use and the nature of the different qualities of sugar. The following description applies primarily to the sugar industry in the Pernambuco district, but is applicable with minor alterations to the sugar industry of Brazil generally:—

Brazilian sugar is manufactured from the sugar-cane, either (1) by the antiquated open pan system or process (called in Pernambuco "bangue"), or (2) by more or less modernized factories.

There are some 1500 old-process factories or "bangues," and 34 or 40 "usinas." Some efforts have of late years been made to modernize the "usinas," but their methods are still primitive in the extreme and wasteful; nearly all should have bagasse furnaces and new crushers. A very small percentage of sugar is extracted from the cane (from 7 to 9½ per cent. in Pernambuco). One factory works by diffusion process, and enormous quantities of wood are necessary to keep it going. The "usinas" are situated in valleys of easy access, and raise their own canes or buy canes from neighbouring plantations. The canes are paid for on a sliding scale, sometimes based on price of "usina" sugar, that is the very first quality produced, sometimes on that of white crystals. The "usinas" make the ordinary centrifugal sugars from brown to white, the whites are turned into what is called here, for want of a better name, "usina" sugars—a white lumpy quality which goes into direct consumption in many parts of Brazil, and is much liked.

In Maceio this quality is not made, and "usina" there is a general name for all sugars produced in modern factories. "Usinas" find their way chiefly to Rio Grande do Sul, Para, and the Amazon Valley, as far as Manaos, and even further up the tributaries of the Amazon, and they, as well as white crystals, are also sold to Rio and Santos.

Brown or yellow centrifugals are, in this market, called "Demeraras," from the circumstance that they were at first supposed to resemble or imitate Demerara sugars. Originally "Demeraras" were crystals for export, about 14 D.S. in colour, testing 96° and corresponding in foreign markets, such as United States and the United Kingdom, to 96° centrifugals. Some "usinas" make very light-coloured second and third runnings, which, according to colour and dryness, find their way to the southern markets and go into direct consumption, in many cases in competition with "mascavado" sugars, which they somewhat resemble.

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*Report by Mr. Vice-Consul Rhind of an Inquiry into the Sugar Industry in Brazil, for the purpose of Collecting Information on which to base an Opinion as to whether the Industry is Bounty Fed.—[Parliamentary Papers: Commercial No. 5 (1906.)]

"*Banques or Open-pan Sugars.*—After canes are ground, the juice is run into large open kettles or pans, and boiled to a point, the molasses again run into clay or metal conical moulds, which are fitted with an outlet below, at first closed. After several days, eight as a rule, the outlet is opened and the molasses is run out, and the sugar made in the mould is bagged and sent to town for sale as wet or "mellado" sugar ("bruto mellado"). This sugar is, as one can readily imagine, subject to very heavy losses in weight, 10 to 20 per cent., and to obviate this, and also to meet the demand from the south, the raw sugar is dried in the sun, and shipped south as dried "brutos" or "bruto secco."

This quality is much liked by a certain class of people in Rio and Santos. The loss by sun-drying varies from 5 to 8 per cent., or even to 10 per cent., according to quality. The sun-dried "brutos" are also used when roasting coffee; in the opinion of many the coffee is thereby much improved.

The raw "bruto" sugar from the pan is also run into a mould, the outlet being closed, and the sugar is covered with clay on which water is poured daily and allowed to percolate through the clay and sugar, the water being renewed every day or two. When ready, the clay is removed and the sugar turned out, the molasses having of course been previously run off. The colour of the sugar from the mould has now changed considerably, the top being a dull white, and the colour varying, in scarcely perceptible gradations, from this dull white to light and dark brown. These layers of sugar are separated, according to the colour, and classified as white, "somenos," and "mascavado." There are regular classifications of each quality, the whites or "brancos" being known as 3a, of which there are three grades, *boa*, *regular*, and *baixo*—that is, "good," "average," and "low." The "semenos" are similarly graded, and "mascavados" also. These gradations of colour are not very clearly defined, and there are infinite varieties, it being scarcely too much to say that no two plantations make the same sugar.

"*Retames.*"—"Retames" are "channels," or sugars made from molasses, and not from cane juice directly. All these sugars are marketed in Recife and sold in small lots to packers, who collect and classify them, making them into uniform grades to suit the various markets, the best sugars going, as already stated, to Rio Grande do Sul or the Amazon ports.

The "bangues" are often situated at considerable distances from the railway stations, and have to send their sugar to the stations on the backs of horses, sometimes a distance of half-a-day, one day, or, in some cases, even two days' journey. The cost of marketing sugar in this fashion is high, but the country is extremely hilly and not adapted for the erection of enormous central factories. The valleys are able to supply canes for only moderate-sized factories.

Unless the crops in Brazil be very small, yielding only sufficient for the home trade, the price of sugar in Brazil is regulated by the value abroad. Only one refinery, in the modern sense, exists in Brazil, situated in Rio. The others, which are on the smallest possible scale, refine by the crudest methods, such as bullock's blood and animal charcoal. The higher qualities of sugar are kept in the country and go into direct consumption, being found even on the table of the fairly well-to-do people. One reason may be that the people still preserve the taste of fifty or sixty years ago in sugar, and have not changed this taste for the modern refined article.

PRODUCT AND CONSUMPTION OF SUGAR.

The total production of sugar in Brazil at the present time is calculated at about 4,500,000 bags of 60 kilogs. each; as the home consumption is estimated at 3,000,000 bags, it is supposed that the quantity available for export is 1,500,000 bags.

It must, however, be remarked that in none of the States is there a record of the consumption in the interior, and as to exports, the statistics given can only attempt to deal with sugars exported coastwise from the various States, there being no official record of sugar sent out by rail, on mule back, &c.

No great expansion in the industry is expected at the present time, the difficulties of transport being too great beyond the immediate zone of the railways. The country generally does not lend itself to cheap transport, being extremely difficult for horse and bullock transport, which are the means generally employed to bring produce to the stations.

COST OF PRODUCTION.

Certain figures with regard to the cost of production at "usinas" are given in the annex, but it must be remarked that it is in a great measure impossible to arrive with accuracy at estimates that can be adopted as expressing the ruling conditions throughout the country. Very few factories are able to furnish anything like reliable statistics of their industrial or financial movement, and, as regards the lower grade of sugar, it is, as a general rule, impossible to arrive at even an approximate average of the cost, the producers being for the most part unfortunately unaware of the importance of giving special attention to records of this nature. In Brazil, however, they are especially necessary for an intelligent appreciation of the situation, there being so many varied systems of taxation—Municipal, State, and Federal—and transport and attendant expenses being on most varied scales, regulated by the position of the factory, proximity to or remoteness from railway, sea, or river communication, nature of land, roads, &c.

It will perhaps be sufficient to deal with the figures given in the Annex for the cost of production in the principal sugar-producing State, viz., Pernambuco, which are, on the whole, the most detailed.

As is explained in the Annex, the price paid for the cane in that State is determined, under a sliding scale, by the market price of sugar. At the standard price, when "usinas" sugars are quoted at 3 milreis per 15 kilogs. (36 fr. per 100 kilogs.),* the price paid to the planters is 6,500 reis (or 11·70 fr.) per 1,000 kilogs. In this State a ton of cane is reckoned to produce a large bag of 75 kilogs. of sugar. (The actual yield, as shown in the published reports of the factories, appears to range from 75 to 90 kilogs.)

If to this we add the cost of milling, we get the following figures for the cost of cane and milling for the grades of sugar specified:—

8,360 reis	(15·05 fr.)	per 75 kilogs.	Usina.
7,900 ,,	(14·22 ,,)	,,	Crystals.
7,850 ,,	(14·13 ,,)	,,	Demeraras.
7,330 ,,	(13·19 ,,)	,,	Bangues.

Before these sugars can be marketed, the cost of transport from the factory to the port of Pernambuco (estimated to average 1,500 reis per 75 kilogs.) must be added.

Even then the total of the above items of the cost of production appears to be only 9,860 reis per 75 kilogs. for "usina" sugar, or 23·66 fr. per 100 kilogs., when the price of such sugar is, by hypothesis, 36 fr., and the apparent difference would of course have been greater if a higher yield than 7·5 per cent. had been assumed.

It must, however, be particularly remarked that the above calculation of cost of production is in reality incomplete, expressing, as it does, the bare outlay on the purchase of cane and in the mechanical and routine operations involved in the manufacture of the sugar. No allowance has been made, and no figures, unfortunately, are available with regard to State and municipal taxation, interest on capital (either fixed or floating), administration, maintenance of properties or depreciation. Except in the case of the State of Rio de Janeiro, where a figure can be given for administration and maintenance of the factory (estimated as equivalent to 2,200 to 2,500 reis, or 3·96 fr. to 4·50 fr. per ton of cane milled), particulars are equally wanting in regard to the sugar industry of other States.

POSITION AND PROSPECTS OF THE SUGAR TRADE.

Certain railway enterprises, which depend at present chiefly on the transport of sugar for their returns, have in project the extention of their systems, and I understand that this fact has given rise to the impression that the prospects of the trade must be encouraging. But I would explain that the real facts confirm just a contrary conclusion, as the extension of railways now being proceeded with, or which are in contemplation, have for their object the opening up of traffic in commercial commodities and agricultural products other than sugar. It has been found, indeed, that the conditions of the sugar trade fail to guarantee an adequate result, and, that it is consequently necessary to carry the railway systems into fresh zones yielding other produce, such as cereals, cattle, cotton, and possibly minerals.

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* Throughout this Report the milreis has been converted at the rate of 1·80 fr.

Banking facilities are primitive and rates of interest very high, the sugar planter being charged 12, 15, 18, or even 24 per cent. for moneys advanced to meet outlay in planting, The taxes, which fall on the sugar industry, both directly and indirectly, are excessively high, and no one cares to risk money in the erection of new factories. In short, the sugar industry in this country is very heavily handicapped by excessive taxation, deficient means of transport, lack of capital, high rates of interest, and heavy railway freights. These freights, however, could not well be other than high, the coal costing considerably more than double its price in Europe, and all other charges being in the same proportion. The same remarks apply to the steamship companies.

The scale of expenditure in Brazil is, in all things, very much higher than in England, and this fact has been recognized by foreign companies, who pay their employés gold salaries. They found that, with the fall in the currency value of gold, these salaries did not provide a fair scale of remuneration, or even furnish a sum adequate for living expenses, if paid at ruling rates of exchange. They have, therefore, regulated these payments at varying rates, which secure to the recipients a result from 30 to 60 per cent. more favourable to them than that derivable from the prevailing exchange.

The effect of fluctuations in exchange on production must not be lost sight of, it being manifest that a rise in the gold value of currency reduces most considerably the results obtained by all engaged in production.

It is, perhaps, not generally understood that the market values of Brazilian productions, sugar as well as other commodities, are really regulated by the values in sterling ruling in London, Liverpool and other import markets.

To descend to greater detail, it may be pointed out that taking the value of a ton of sugar polarizing 84 to 86 degrees in Liverpool at about £7 5s. (say, 181·25fr.), with an exchange of 12d. per milreis, this would mean for the Brazilian producer 145 milreis per ton, representing a fair return.

When the exchange reaches, for example, 17½d., as at the present moment, the value of the sugar, on a sterling basis, on the consuming markets is still the same, but its conversion into Brazilian currency represents only 99,400 reis, meaning a difference in the returns to the producer of no less than 31 per cent., which possibly on the scale of expenditure already shown may cause the producer an actual loss.

It has been strongly questioned whether producers really sell their sugar at a loss as alleged. There seems, however, no doubt that, during the present crop, the greater number of sales have been made at an actual loss. The question then naturally suggests itself: Why do planters, and producers generally, continue operations under such adverse circumstances? The reason lies in the fact that, once the cane is fit to be cut, it must be cut in order to obtain from the same roots a regrowth for the following year, and, as the planters always hope that the next year may see an improvement, they prefer to cut their cane, even if this may involve a loss, rather than, by abandoning the cane in one year, to lose both the present and the following crop.

It may be further remarked that, according to recorded results, sugar production may be said to run in a four-yearly cycle. In one year, as the present, the crop will be very large, and the consumption of the country considerably over supplied; there is, consequently, a very heavy fall in prices. In the second year there will be a fair crop, as although no new cane will have been planted, there will be a large return from regrowth of last year's ratoons. Internal prices may therefore somewhat improve, but, on the whole, they will not prove remunerative. In the third year there will be a small crop, perhaps barely sufficient for internal consumption. Prices will then improve greatly, and in consequence, the planters will again begin to plant on a large scale, so that, in the fourth year, we return once more to a large crop and low prices.

Matters, however, have latterly become so bad that the planters, unable to obtain loans from their agents, or profits from the sugar marketed, found themselves without resources, and were thus compelled in many case to abandon their cane. In the hope of enabling the cane producer to market his produce without actual loss, and thereby encourage him to cut his cane with a prospect of obtaining a profit from it next year, an understanding was arrived at between the Government, the Great Western of Brazil Railway, and other companies interested in the transport of sugar, whereby a reduction of 25 per cent. on all freights and taxes was conceded to the classes interested. These facts tend to show that the reported unsatisfactory condition of the sugar industry in Brazil has ample foundation.

It is alleged, indeed, that many of the factories during the slack season are dependent on the bye-products, particularly alcohol consumed in Brazil, for paying their expenses, the results obtained from the sugar itself being unremunerative.

(To be continued.)

The Azores get their sugar chiefly from the United Kingdom and Germany.

THE TRUE AND APPARENT QUOTIENT OF PURITY OF THE JUICE FROM THIRTY-FIVE VARIETIES OF CANES.*

It has been observed on many occasions that the polarimetric determination of sucrose in cane juice gives results which are somewhat too high, thus giving rise to abnormally high quotients of purity, these occasionally closely approaching to, or even exceeding, 100.

This subject has been carefully studied by H. C. Prinsen Geerligs, who has collected the available information in a useful paper published in the *International Sugar Journal*, Vol. II., 1900, p. 145, in which he makes a most careful study of the subject, but which he is finally obliged to leave without adequate explanation.

In order to ascertain whether any of the thirty-five varieties under experimental cultivation at Antigua exhibited any evidences of abnormal quotients of purity, juice from each variety grown at Cassada Garden, Antigua, was submitted to double polarization after Clerget's method. The results are given in the table on the next page.

In calculating this table Clerget's original factor 144 was used: the factor 142·5 is, however, frequently employed. Its use would cause the true sucrose to appear about ·02 lb. per gallon higher than in the table, and the "true purities" would be about 1·0 higher. It is questionable which is the better factor to employ, but with this uncertainty it is obvious that it is only necessary to regard as possessing abnormal apparent purities those juices which show a divergence of more than 1·0 between the apparent and true purities.

Out of the thirty-five canes examined we find six which show what may be regarded as abnormally high apparent purities, namely, Red Ribbon, Queensland Creole, D. 74, D. 89, D. 99, and D. 116.

These results are placed on record in view of the interest attaching to this, as yet, partially explored field. It was hoped that some light might be thrown on the difficult questions relating to the presence of gum, and it may be that the substances here interfering with the determination of sucrose are connected with the bodies known as gums; but if they are, it must be observed that they are not precipitated by basic acetate of lead, with which the juices are clarified. Those interested in these questions are particularly referred to H. C. Prinsen Geerligs' paper already cited.

During the dry season just past, considerable trouble has been experienced from "gum," which appears to be worse when the normal development and ripening of canes are arrested.

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* An Appendix to the Report of *Sugar Cane Experiments in the Leeward Islands*, prepared by Dr. Francis Watts, C.M.G.

RESULTS OBTAINED IN THE EXAMINATION OF THE JUICE FROM THIRTY-FIVE VARIETIES OF CANE GROWN ON CASSADA GARDEN ESTATE.

No.	Name of Cane.	Direct Polarization.	Polarization due to Sucrose—Clerget.	Apparent Sucrose. Pounds per gallon.	True Sucrose. Pounds per gallon.	Difference between True Sucrose and Apparent Sucrose.	Apparent Purity.	True Purity.	Difference between True Purity and Apparent Purity.
1	Sealy Seedling ..	83·5	83·6	2·171	2·174	+·003	91·1	91·3	+0·1
2	Burke	83·1	82·5	2·161	2·145	—·016	92·6	91·9	—0·7
3	Louzier..	77·2	77·4	2·007	2·012	+·005	88·1	88·3	+0·2
4	Red Ribbon	87·1	80·5	2·265	2·093	—·172	95·5	88·4	—7·1
5	Queensland Creole.	88·5	86·9	2·301	2·259	—·042	93·6	91·9	—1·7
6	Naga B.	87·5	86·7	2·275	2·254	—·021	93·3	92·5	—0·8
7	White Transparent	86·6	86·2	2·252	2·241	—·011	94·8	94·4	—0·4
8	Rappoe	84·9	84·1	2·207	2·187	—·020	93·9	93·1	—0·8
9	Mont Blanc.. ..	85·9	85·9	2·233	2·233	—·000	94·0	94·0	—0·0
10	Caledonian Queen .	87·3	86·6	2·270	2·252	—·018	95·0	94·2	—0·8
11	B. 393	89·4	89·1	2·324	2·314	—·010	93·3	93·0	—0·3
12	B. 376	88·2	87·1	2·293	2·265	—·028	95·4	94·3	—1·1
13	B. 306	85·8	85·6	2·231	2·226	—·005	92·2	91·9	—0·3
14	B. 208	87·5	86·8	2·275	2·257	—·018	94·2	93·5	—0·7
15	B. 156	75·9	75·8	1·973	1·971	—·002	89·2	89·1	—0·1
16	B. 147	81·4	81·5	2·116	2·119	+·003	93·2	93·3	+0·1
17	T. 2	81·8	80·5	2·127	2·093	—·034	94·2	92·7	—1·5
18	T. 79	75·2	75·1	1·955	1·953	—·002	92·4	92·3	—0·1
19	T. 83	89·6	89·0	2·330	2·314	—·016	94·5	93·9	—0·6
20	T. 166	91·9	91·7	2·389	2·387	—·002	95·1	95·0	—0·1
21	T. 189	84·2	83·7	2·189	2·176	—·013	92·2	91·7	—0·5
22	T. 192	87·9	88·2	2·286	2·293	+·007	94·4	94·7	+0·3
23	T. 211	88·5	88·2	2·301	2·293	—·008	91·4	91·1	—0·3
24	D. 49	79·2	78·9	2·059	2·052	—·007	92·4	92·2	—0·2
25	D. 61	78·7	78·1	2·046	2·031	—·015	90·9	90·2	—·07
26	D. 69	80·8	80·6	2·101	2·096	—·005	89·7	89·4	—0·3
27	D. 74	78·4	77·1	2·038	2·005	—·033	89·0	87·6	—1·4
28	D. 89	81·8	79·9	2·127	2·077	—·050	91·9	89·7	—2·2
29	D. 95	82·4	81·8	2·143	2·127	—·016	92·4	91·7	—0·7
30	D. 99	81·9	80·6	2·129	2·096	—·033	92·1	90·6	—1·5
31	D. 115	77·7	77·8	2·020	2·023	+·003	89·4	89·5	+0·1
32	D. 116	78·7	77·4	2·046	2·012	—·034	89·2	87·7	—1·5
33	D. 117	85·7	84·9	2·228	2·207	—·021	93·4	92·7	—0·7
34	D. 130	81·3	81·2	2·114	2·111	—·003	91·5	91·4	—0·1
35	B. 109	79·2	79·0	2·059	2·054	—·005	90·9	90·7	—0·2

CONSULAR REPORTS.

JAVA.

The British Consul reports:—

The year under review may certainly be regarded as a satisfactory one. The sugar crop, it is true, was smaller than its predecessor, but against this must be placed the very remunerative prices realised by planters for this article as well as for tobacco crops, while the coffee crops also exceeded estimates.

Notwithstanding the fact that the planted area was slightly larger, the 1905 sugar crop only yielded a production of 1,028,357 tons, or a decrease of 36,398 tons as compared with that of the previous year. This must be attributed to the unfavourable weather experienced during the planting season; at the time when copious rains were most required there occurred periods of drought, which had an injurious effect on the canes and resulted in the juices being of inferior quality. The satisfactory prices obtained by planters, recorded in my last report, were not only well maintained but later in the season rose to a level which has not been approached for some years.

With regard to cane diseases, Mr. Vice-Consul Rose reports as follows:—

"Progress is noticeable in the endeavours made to eradicate the many diseases to which sugar cane is liable, the success in great measure being due to the process of careful selection. The best results were again obtained from the seedlings, the popularity of which increases annually. The foreign cane has fallen into disfavour and is likely soon to be entirely abandoned, while the indigenous cane, although yielding good results, proves expensive through having to be nurtured in gardens in the hills.

Exports of Sugar Crop for Year ending December 31st, 1905, compared with the Years 1904 and 1903.

Country.		Quantity.	
	1903. Tons.	1904. Tons.	1905. Tons.
United States	249,319	422,943	397,520
China	171,622	108,593	131,995
Japan	108,685	90,663	110,283
British India	59,613	81,143	83,328
United Kingdom	26,126	55,511	9,230
British Columbia	10,868	16,732	—
Australia	72,096	14,000	16,959
Continent of Europe	1,302	4,565	142
Other Countries	34,950	40,098	70,266
Total	734,581	834,248	819,723

As foreshadowed in my last report, the profits made by mills on the 1904 working were in most cases expended on new machinery, and the majority of the mills in Java may now be said to be up to date as far as installation is concerned. Many are now capable of producing, in addition to the usual qualities, superior sugar, which in shade and grain most nearly approaches the refined article, and finds a ready market in India.

BOLIVIA.

In the department of Santa Cruz, which is at a lower altitude, and consequently warmer than Sucre, and the eastern and north-eastern half of Chuquisaca there are about 30 manufacturers of cane sugar, who each produce from 1,000 to 10,000 cwts. of raw sugar annually. This takes the place of at least one-half of the imported refined sugar from Germany, though it cannot, except in Santa Cruz and Beni, compete with it in price. In 1904 it was sold in Santa Cruz at 13s. to 16s. per cwt. In 1905 the bad harvest brought the price up to £1 8s. and £1 10s. per cwt. Imported into Sucre it sells well at £3 per cwt. The greater part of the production of Santa Cruz goes to the departments of Beni, Chuquisaca, Cochabamba, and, owing to the favourable roads along the eastern frontier, to Tarija, a distance of about 300 miles by mule track.

HAWAII.

The total tonnage of the sugar crop for 1904-05 was 426,248 short tons (380,579 tons avoir.), which is the largest crop in the history of the islands, with the exception of that for 1903, which exceeded it by 11,743 short tons (10,485 tons avoir.).

There are 53 sugar plantations in the Hawaiian Islands, situated as follows:—Hawaii, 25; Kauai, 11; Oahu, 9; Maui, 8; all having agencies in Honolulu, on Oahu. Of these plantations, all have their own factories except eight, which have their cane ground and manufactured at adjoining factories.

Hawaiian sugar is all exported in the raw state with the exception of the output of one factory, the Honolulu Plantation Company, which does not turn out any raw sugars. In this factory white sugars in granulated and powdered styles are manufactured and shipped to San Francisco, its output being about 20,000 short tons (17,860 tons avoir.) per annum.

The raw sugars are sold under contract to the American Sugar Refinery Company of New York, the Western Sugar Refining Company of San Francisco, and the Californian and Hawaiian Sugar Refining Company of San Francisco. The last-mentioned company is controlled by certain Hawaiian sugar-planting companies owning about 82 per cent. of the whole output of the island.

Raw sugars are sold to the refineries above named on the basis of the prices of Cuban centrifugals in New York. This basis during the year 1905 rose from 4·90c. duty paid, at which price it stood at the beginning of the year, to 5¼c. per lb., which price was touched on January 23rd. Beyond this it did not go. The year's prices on the whole were very satisfactory, although there was a serious decline in values during the last three months of the year. By that time, however, almost all the Hawaiian crop was marketed.

The following is extracted from the report for 1905 of the governor of this territory to the United States Secretary of the interior :—

"A few years ago a sugar cane pest (*Perkinsiella saccharicida, Kirk.*) made its appearance in the sugar cane fields of Hawaii, introduced, it is supposed, from Australia. It has been stated that this pest caused a monetary loss of upwards of $3,000,000 to the sugar interests of Hawaii during the past year. It was so destructive to the industry that the Hawaiian Sugar Planters' Association a year ago joined the Territorial Board of Agriculture and Forestry and engaged Professor R. C. L. Perkins, then acting superintendent of entomology for Hawaii, to accompany Professor Koebele on a mission to Australia to search for the natural enemies of the 'cane leaf hopper.' It did not take their trained eyes long to discover the insects that were holding that insect in check. A few of each were successfully introduced and established here, and now they have been propagated and planted on the various islands and are well established wherever placed. One of the most important is a very minute fly that destroys the eggs of the 'leaf hopper' by inserting its ovipositor in the leaf hopper egg and deposits therein an egg, which soon hatches into a small blind footless grub, afterwards changing to a pupa and fly, and in the latter stage it cuts its way out and is soon ready to continue the good work.

"The Federal experiment station has a division of entomology . . . and it gives special attention to agricultural pests. The Hawaiian Sugar Planters' Association has a large and well-organized staff of entomologists devoting their entire time to insects pertaining to sugar cane and the propagation of parasites and predaceous insects that infest cane."

Unfortunately insects are not the only enemy of the cane. Fungoid growths are also accountable for much loss to planters.

The Hawaiian Sugar Planters' Association above referred to is maintained at a cost of about £14,500 per annum, subscribed for *pro rata* on their output by the combined plantations.

ROUMANIA.

An arrangement has been made by the Government with the five sugar refineries now working in Roumania, under which the bounty on manufactured sugar is reduced from 16 c. to 11 c. the kilo. (1 fr. of 100 c. = 9½d.). This will effect a saving to the Government of £40,000 per annum for the period of eight years, at the end of which the bounties come to an end. *Per contra* the tax on exportation instead of being 11 c. the kilo., will be reduced to 9 c. for the first 5,000,000 kilos. (5,000 metric tons) exported in each year.

In consideration of the sacrifices made by the refineries, the State engages itself for the next eight years not to accord any bounty for sugar, or any other advantages to any new factory, and it also engages, for a period of 12 years, *i.e.*, till the expiration of the term for which the new Treaties of Commerce last, not to lower the present import duties (35 fr. per 100 kilos. = 14s. 3d. per cwt.) on foreign sugar.

The five companies interested paid in 1905 dividends amounting to £80,000 on a capital of £1,000,000.

By the new arrangement, which came into force on April 1st, the sugar companies will lose about one-half of their present dividends, but they will be assured almost certain profits for the next eight years.

PERU.

The British Consul-General reports:—

Sugar forms one of the staple articles of export of Peru. The quantity exported in 1905 was 134,000 tons valued at about £1,500,000. Owing to the drought there has been a deficiency in the crop. In fact, the prospects of the sugar growers are not encouraging. There will be little to stimulate a further expansion of the acreage under sugar cultivation until vast irrigation works are undertaken by the Government. Besides irrigation new machinery, as stated elsewhere in this report, is indispensable. When these essential requirements have been met intensive sugar cultivation can be undertaken in Peru, provided of course that the state of the market in future warrants renewed efforts on the part of those engaged in this most important industry.

PUBLICATIONS RECEIVED.

THE HACENDADO MEXICANO'S YEARLY SUGAR REPORT, 1905-06. This, the seventh annual edition, is as usual replete with information about Mexican sugar. It contains an "official list" of cane growers and sugar manufacturers in Mexico, Central America, Porto Rico, Cuba, Argentina, Peru, Hawaii, and Java. To be procured from Apartado 2010, Mexico City.

DIRECTORY OF LOUISANA SUGAR PLANTERS FOR 1906. Compiled by the *Sugar Planters' Journal*, 520, Poydras Street, New Orleans, U.S.A. Price $1·00. 8 pages, royal 8vo.

DER DEUTSCH-AMERIKANISCHE HANDELSVERTRAG UND DIE KUBANISCHE ZUCKERPRODUCTION (The German American Treaty and the Cuban Sugar production), by Prof. Julius Wolf (Breslau). Gastav Fischer, Jena. Mks. 3. Paper covers. The author, who is a professor of political economy in the University of Breslau, has already published several works dealing with "sugar economy." In his latest work he attempts to show that the U.S.A. treaty with Cuba is a violation of the most-favoured-clause in the German-American Treaty, and wishes to impress on the German Government the necessity of protesting against it. The action of the German Government has hitherto been considered by the U.S.A. Government as so much "bluff," and the author thinks that serious action may force the U.S.A. to revoke the Cuban preferential sugar treaty. Professor Wolf criticises the recent pronouncements (of Prof. Herzfeld, Prof. E. von Lippmann und Sigmund Stein) claiming the superiority of beet over cane, and declares that in the coming contest cane sugar will be the victor. Included in the work are a large number of tables giving statistics of sugar production, consumption, export, import, yields, prices, &c., and the whole forms a most interesting study of the "political economy of sugar."

MONTHLY LIST OF PATENTS.

Communicated by Mr. W. P. THOMPSON, C.E., F.C.S., M.I.M.E., Chartered Patent Agent, 6, Lord Street, Liverpool; and 322, High Holborn, London.

ENGLISH.—APPLICATIONS.

13217. E. A. BARBET, London. *Process of sulphurising saccharine juices in fermentation and desulphurising such juices.* (Date applied for under Patents Act, 1901, 27th October, 1905, being date of application in France.) (Complete specification.) 7th June, 1906.

ABRIDGMENTS.

11838. J. WETTER, London. (Communicated by M. Weinrich, of Yonkers, in the State of New York, United States of America.) *Process for purifying masse-cuite, syrups or impure sugar solutions.* 6th June, 1905. This invention relates to a process for purifying masse-cuite or impure sugar solutions, which consists essentially in bringing the solution to a density of at least 36° Bé, warming the said solution to about 43° to 45° C, mixing intimately and substantially uniformly therewith a quantity of dry finely powdered caustic or hydrated lime or thick milk of lime in proportion to the impurities present, and carbonating at temperatures below 45° C.

12841. G. B. NUTT, Pittsburgh, in the State of Pennsylvania, United States of America. *Improvements in grinding or crushing rolls.* 21st June, 1905. This invention relates to grinding or crushing rolls, the combination of a plurality of shafts, two rolls on each of two of said shafts, a set of sheaves supported on each of two of said shafts and in line with each other, an endless rope or band connecting said set of sheaves; said sheaves being so located that said rope or band lies between the pair of rolls on each of the two shafts, and means for exerting a pull on said rope or band.

20866. L. C. Trent, of Van Trent, County of Placer, State of California, United States of America. *Improvements in or relating to centrifugal filters.* 14th October, 1905. This invention is designed for separating or expelling the water or liquid from the mass or body of material to be treated, such as slimes and peat and sugar; although the machine is equally as well adapted for the treatment of any material from which the water contained therein is to be removed or extracted, the object of the invention being to deliver the filtered material, which is received in the form of a pulp, in a solid and comparatively dry condition, from the surface of a revolving screen, on to which the material to be treated is delivered from any suitable source of supply.

GERMAN.

ABRIDGMENTS.

170120. H. Butsch & Co., of Hagen, Westphalia. *A shreddings knife box with divided knives and bar against which the knives bear.* 19th February, 1904. This shreddings knife box is characterized by both the heads as well as the nuts of the screws serving for fastening the knife being provided with spherical or rounded support surfaces and mounted in suitably shaped recesses or countersunk parts, but the screw holes in the knives being made eccentric to those of the support bar, so that the screws press the divided knife when fixed both against the contact piece as well as against one another. In a modified form of the shreddings knife box, the holes in the knives and support bar have such an eccentric position that only one divided knife is pressed against the contact bar and at the same time is is exposed to lateral pressure from the other.

169888. Henry Schwarz, of Longmont, Colorado. *Apparatus for regulating the density of the juice in extraction apparatus, more particularly for the sugar industry.* 21st March, 1905. This apparatus is characterized by two valves arranged in the juice boxes, one of which valves closes the return pipe for the juice and the other the discharge pipe, and both are regulated by a rocking beam which is weighted by means of a measuring vessel through which juice flows at an always uniform level, in such a way that the lighter the juice the more the juice return valve is opened, and the discharge valve closed and *vice versa.*

170297. A. Wernicke Maschinenbau Aktien-Gesellschaft, of Halle-on-Saale. *A process for casing sugar using a centrifugal with concentric straining drums.* 8th December, 1904. In this patent a process is described for casing sugar, using a centrifugal with two concentric straining drums and steam, water or non-saturated sugar solution as casing medium, and consists in both drums being fed with sugar but the casing medium being only introduced into the inner drum in order that it may here become saturated and consequently the centrifugalled sugar in the outer drum may remain unaltered in quantity and form.

170296. August Neumann, of Berlin, and Walter Raabe, of Broistedt. *Mixing, heating and feeding arrangement for diffusers.* 29th July, 1905. This arrangement consists in a feed hopper being provided in the upper part of each diffuser, the walls of which are perforated with tangentially or radially placed apertures, with the object during the ordinary soaking of the shreddings in the diffusers to operate a thorough mixing of the shreddings with the hot water or the like in spray during the feeding of the diffuser. In another form of construction of the apparatus the diffuser is provided with a central and adjustable truncated conical bottom piece for the purpose of diverting the current of shreddings against the walls of the diffuser.

170152. Theodor Drost, of Charlottenberg. *A mashing vessel for assisting the crystallization of sugar substances and for thoroughly mixing other pasty masses with diluting substances.* 11th January, 1905. In this mashing vessel for assisting the crystallization of sugar masses and for thoroughly mixing other pasty substances with diluting substances, stirrer arms are provided which in addition to a rotary motion round the axis of the shaft of the mechanism also receive a compulsory rocking motion. In the mashing vessel hereinbefore described a rotary gear is also provided having crank shafts which serve for moving push rods flexibly connected with the ends of the stirring arms.

Note.—Copies of all published specifications with their drawings in these lists can be obtained from W. P. Thompson & Co., 6, Lord Street, Liverpool, at One Shilling a copy for English or American Patents, and Two Shillings for German. In ordering please give number and date.

Patentees of Inventions connected with the production, manufacture and refining of sugar will find *The International Sugar Journal* the best medium for their advertisements.

The International Sugar Journal has a wide circulation among planters and manufacturers in all sugar-producing countries, as well as among refiners, merchants, commission agents, and brokers, interested in the trade, at home and abroad.

IMPORTS AND EXPORTS OF SUGAR (UNITED KINGDOM

To end of June, 1905 and 1906.

IMPORTS.

Raw Sugars.	Quantities.		Values.	
	1905. Cwts.	1906. Cwts.	1905. £	1906. £
Germany	1,769,736	4,814,084	1,154,259	2,049,572
Holland	76,636	47,370	55,877	17,868
Belgium	274,915	232,450	206,066	92,709
France	102,073	158,805	75,708	67,251
Austria-Hungary	253,628	146,504	182,622	60,140
Java	1,271,923	158,997	942,159	73,466
Philippine Islands	....	....	....	....
Cuba	....	111,910	....	41,943
Peru	690,816	394,903	499,755	178,275
Brazil	27,996	923,281	18,087	358,915
Argentine Republic	....	....	....	....
Mauritius	139,034	52,523	78,350	20,368
British East Indies	212,210	61,827	116,222	24,110
Straits Settlements	120,361	40,449	63,466	16,984
Br. W. Indies, Guiana, &c.	724,581	1,162,453	610,576	630,663
Other Countries	610,655	156,185	436,314	72,230
Total Raw Sugars	6,274,564	8,461,741	4,439,461	3,704,494
Refined Sugars.				
Germany	4,895,780	6,004,719	4,109,798	3,409,798
Holland	672,761	1,365,261	591,567	811,696
Belgium	124,133	196,248	108,541	113,225
France	637,577	1,098,292	539,342	609,745
Other Countries	268,059	436	219,754	323
Total Refined Sugars	6,598,310	8,664,956	5,569,002	4,944,787
Molasses	1,158,508	1,334,468	235,029	255,380
Total Imports	14,031,382	18,461,165	10,243,492	8,904,661

EXPORTS.

British Refined Sugars.	Cwts.	Cwts.	£	£
Sweden	184	127	168	114
Norway	9,908	8,592	7,885	5,161
Denmark	39,648	53,726	30,494	27,109
Holland	36,713	39,057	30,155	23,053
Belgium	2,977	5,208	2,198	2,881
Portugal, Azores, &c.	8,153	17,831	6,316	9,636
Italy	1,344	20,461	964	10,496
Other Countries	116,139	303,136	109,733	195,259
	215,066	448,138	187,913	273,709
Foreign & Colonial Sugars				
Refined and Candy	10,080	21,859	9,683	13,342
Unrefined	28,736	118,389	22,214	61,020
Molasses	992	5,302	378	1,638
Total Exports	254,874	593,688	220,188	349,709

UNITED STATES.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1906. Tons.	1905. Tons.
Total Receipts Jan. 1st to July 19th	1,175,442	1,052,187
Receipts of Refined ,, ,,	1,305	748
Deliveries ,, ,,	1,203,365	972,903
Consumption (4 Ports, Exports deducted) since January 1st	1,033,775	899,555
Importers' Stocks July 18th	30,610	79,284
Total Stocks, July 25th	322,000	220,080
Stocks in Cuba, ,,	148,000	300,000
	1905.	1904.
Total Consumption for twelve months	2,632,216	2,767,162

CUBA.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1905 AND 1906.

(Tons of 2,240lbs.)	1905. Tons.	1906. Tons.
Exports	705,005	855,903
Stocks	351,879	249,544
	1,056,884	1,105,447
Local Consumption (six months)	21,790	22,100
	1,078,674	1,127,547
Stock on 1st January (old crop)	—	19,450
Receipts at Ports up to June 30th	1,078,674	1,108,097

Havana, June 30th, 1906. J. GUMA.—F. MEJER.

UNITED KINGDOM.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION FOR SIX MONTHS ENDING JUNE 30TH.

SUGAR.	IMPORTS. 1904. Tons.	 1905. Tons.	 1906. Tons.	EXPORTS (Foreign). 1904. Tons.	 1905. Tons.	 1906. Tons.
Refined	442,044	329,915	433,248	766	504	1093
Raw	380,080	313,728	423,087	2,691	1,437	5,919
Molasses	43,454	57,925	66,723	32	49	265
Total	865,578	701,568	923,058	3,489	1,990	6,277

	HOME CONSUMPTION. 1904. Tons.	 1905. Tons.	 1906. Tons.
Refined	453,292	326,758	411,749
Refined (in Bond) in the United Kingdom	246,948	250,695	276,624
Raw	62,650	50,081	59,701
Molasses	41,046	56,070	62,977
Molasses, manufactured (in Bond) in U.K.	31,170	25,781	30,926
Total	835,106	709,385	841,977
Less Exports of British Refined	13,835	10,753	22,407
Total Home Consumption of Sugar	821,271	698,632	819,570

Stocks of Sugar in Europe at uneven dates, July 1st to 21st, compared with previous Years.

In thousands of tons, to the nearest thousand.

Great Britain.	Germany including Hamburg.	France.	Austria.	Holland and Belgium.	Total 1906.
181	801	544	380	171	2077

	1905.	1904.	1903.	1902.
Totals	1436 ...	1895 ..	1998 ..	2111

Twelve Months' Consumption of Sugar in Europe for Three Years, ending June 30th, in thousands of tons.

(Licht's Circular.)

Great Britain.	Germany.	France.	Austria-Hungary	Holland, Belgium, &c.	Total 1905-06.	Total 1904-05.	Total 1903-04.
1794	1011	639	514	184	4142	3901	4133

Estimated Crop of Beetroot Sugar on the Continent of Europe for the current Campaign, compared with the actual crop of the three previous Campaigns.

(From Licht's Monthly Circular.)

	1905-1906. Tons.	1904-1905. Tons.	1903-1904. Tons.	1902-1903. Tons.
Germany	2,425,000 ..	1,598,164 ..	1,927,681 ..	1,762,461
Austria	1,510,000 ..	889,373 ..	1,167,959 ..	1,057,692
France	1,085,000 ..	622,422 ..	804,308 ..	833,210
Russia	1,000,000 ..	953,626 ..	1,206,907 ..	1,256,311
Belgium	330,000 ..	176,466 ..	209,811 ..	224,090
Holland	210,000 ..	136,551 ..	123,551 ..	102,411
Other Countries .	410,000 ..	332,098 ..	441,116 ..	325,082
	6,970,000	4,708,758	5,881,333	5,561,257

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☞ The Editor is not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

NOTES AND COMMENTS.

Another Sugar Refinery for Sale.

The Rawcliffe Bridge Sugar Refinery, Goole, is in the market and will be offered for sale by auction on the 19th inst. The property is 19 acres in extent, of which ten acres are occupied by deep water reservoirs; and there are 35,000 square feet of floor space. Although specially constructed for the purposes of a refinery, it is suggested the buildings could easily be adapted to produce white sugar, ready for consumption, direct from the beetroot. The existing plant is equal to an output of 300 tons of refined sugar per week. Whether it would prove useful as a central factory depends very much on its proximity to a suitable agricultural area where beets might be grown. As, however, it has a frontage on the Aire and Calder canal, at least one objection is removed. The agents for the sale are Messrs. Simpson, North, Harley & Co., 1, Water Street, Liverpool.

The Societe Generale des Sucreries.

The Cairo Mixed Tribunal having sanctioned the reconstruction of the Société Générale des Sucreries et de la Raffinerie d'Egypte, some keen competition appears to have arisen in financial circles for securing control of this undertaking. Till its collapse last September this firm was under the influence of a French group, but lately attempts have been made on the part of a London syndicate under Sir Ernest Cassel to supersede the French control. Now a third competitor has arisen in the form of a German syndicate associated

THE STATUS OF THE BRAZILIAN SUGAR INDUSTRY.*

(Continued from page 424.)

NON-EXISTENCE OF BOUNTIES.

There is absolutely no positive evidence of the existence of bounties, direct or indirect. On the contrary, the result of every inquiry in this connection tends to demonstrate their non-existence.

With regard to the special concession alleged to exist in the State of Alagoas, granting a small premium of 2,000,000 reis to the raisers of sugar cane under certain defined conditions, and upon which so much emphasis has been placed, there would appear to be no doubt that this grant was intended to act purely as an incentive to the extension of interest in the sugar industry, and was in no way looked upon as creating a bounty.

Whatever its intention, it has been verified that the decree never entered into active operation. The prize has never been applied for, allotted, or paid. And, in fact, the decree was finally rescinded by government notice issued on the 23rd January, 1906.

Were there bounties direct or indirect, it might be supposed that there would not be so great a fluctuation in prices for internal consumption, and it might be expected that even in the years of large production the prices of sugar consumed in the country would be maintained at a remunerative level.

That this is not the case is seen by examining the prices ruling during the crops of 1901-2 and 1905-6.

CARTELS.

With reference to the existence of cartels, it cannot be questioned that there have undoubtedly been attempts to bring them into operation in trade interests. In fact, with a protective legislation in force such ideas are naturally engendered. But, at the same time, it is equally undoubted that all attempts to encourage their formation have signally failed.

The failure may be attributed to various influences, amongst which the following may be enumerated :—

1. Uncertainty as to the loyal adherence of subscribers to the terms of their association.

2. The fact that the sugar cane raising and sugar producing industries are in the hands of numerous small producers, the sugar supplied by the large factories or large " usinas " being only about

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*Report by Mr. Vice-Consul Rhind of an Inquiry into the Sugar Industry in Brazil, for the purpose of Collecting Information on which to base an Opinion as to whether the Industry is Bounty Fed.—[Parliamentary Papers: Commercial No. 5 (1906.)]

one-third of the total in Pernambuco, and considerably less in Alagoas, the principal sugar-producing States in the north.

3. The great extent of the sugar-raising territory, and the possibilities of interchange of the commodity between the various States, rendering it essential that a cartel, in order to exercise an effective control over the markets, should have at its disposal means to control the entire country, and not merely a limited district. Should, for instance, an organization in Campos attempt to maintain prices at an unduly high level in Rio de Janeiro, which is the principal market for their output, their purpose would be at once frustrated by shipments of sugar being sent to that market from other producing States. This fact explains to some extent the failure of the movement towards the formation of a cartel in that district, and must inevitably prevent the successful operations of a similar local organization in the future.

The volume of sugar consumption within the sugar producing states themselves bears so small a proportion to the total production of those States that the formation of any cartel based on the maintenance of unduly high prices within the state itself may be regarded as altogether out of the question. The fact that prices in the ports of the producing States are independent of the destination of the sugar appears incontrovertible.

4. The fact that the formation of cartels of this nature must inevitably depend on the assistance of foreign capital, which it would be difficult or impossible to enlist in the cause under actual circumstances, such as high exchange, the speculative nature of the industry, and the unsettled nature af the fiscal policy of the country.

SYNDICATES.

The impression that cartels have an established existence in Brazil is probably traceable to the fact that, in all sugar-producing towns and districts, there are certain associations operating under the title of syndicates.

It becomes necessary to point out, however, that the term "syndicate," as employed in Brazil, has quite a different signification as compared with its use either in Europe or in the United States.

These syndicates, in short, appear to be neither more nor less than organizations for directing matters connected with the cultivation of sugar cane, and the production of sugar in the various districts. A principal part of their function seems to be the representation of their members in action required by the Federal and State Governments for obtaining the privileges to which they are entitled under the terms of the Customs Tariff and Budget Laws, such as the acquisition and importation, free of duty, of materials, machinery, and appurtenances, and for defending, when required, the interests of their constituents in the tribunals of the country.

As an Association illustrative of this kind of combination, I would refer to the statues of the "Syndicato Assucareiro da Bahia."

This society, in addition to the services enumerated, is no doubt of use in regulating the sale of the products of the various members, to whom they advance money, when required, under commercial conditions: undoubtedly also this syndicate has enabled the factories to maintain prices at a better level. But it cannot be called a trust or cartel, as their prices are, perforce, subject to those ruling in other States with which they have no combination. This situation is demonstrated by the fact that last year 3,806 bags were received in Bahia from Pernambuco and other northern ports by firms not belonging to the Syndicate, and sold in competition with the supplies under the charge of that Association.

CAPITAL.

There would appear to prevail a rather general opinion that there are many sugar factories in the country working on the support of capital furnished by the States Governments. There are really no factories owing their existence to this nature of support. But the idea has doubtlessly been engendered by the fact that many factories in the States of Bahia and Pernambuco were originally founded by capital lent by the States' Governments. The loans, however, were supplied under stipulations such as are usual in all commercial transactions. For example, in Pernambuco the money was lent by giving State bonds bearing interest at 7 per cent., these bonds being afterwards sold for what they would realise, and the proceeds applied to the construction and equipment of the "usinas." These factories, having been unable to meet their engagements to the lending State Government, are now under the control of the States, which are taking such measures, in their relations with these factories, as they consider desirable to secure themselves against loss, or, in any case, to reduce their loss to the minimum point. There are two factories in the State of Bahia working under these conditions, the rate of interest on capital lent being 6 per cent. per annum, which, it would appear, also provides for amortization.

In the State of Pernambuco there are twenty-seven "usinas" to which money was lent by the State.

Latterly the State has been obliged to come to terms with the owners of these "usinas," cancelling in many cases as much as three-quarters of their indebtedness from the issue of the bonds and accumulated interest, the debtors alleging that they were unable to pay. For the payment of the balance still owing, the Government have adopted the system of levying a contribution on all "usinas" in arrears with their payments of 2,500 reis on white and 1,500 reis on Demerara per bag produced.

REVENUE LAW OF 1906.

The Revenue Law of 1906 contains provisions connected with the sugar industry of Brazil, certain of which would appear at first sight to indicate the intention of the Government to confer benefits on that industry which might be held to be of the nature of a bounty. Reference may particularly be made to the following clauses :—

"Clause 10. Authorising the Government to enter into agreements with coffee-producing States of the Union for the purpose of

(*a*) Regulating the coffee trade;

(*b*) Promoting the appreciation of the article;

(*c*) Organising and maintaining a regular service for spreading its use, in order to increase the consumption.

"The Federal Government may indorse the credit operations which, for this purpose, may be entered into by the State Governments, provided the following conditions be observed:—

"(*a*) The State Governments will make over to the Union a guarantee in gold sufficient for the service and payment of interest and amortization of the loan;

"(*b*) This guarantee shall be of a definitive character for all the term of the loan, and shall not depend on the laws of an annual effect, that is, revocable every year by the legislative powers of the States;

"(*c*) The product of the credit operations shall be applied only to the maintenance of a minimum price for coffee exported, and must not be used for loans or advances to planters, intermediaries, exporters, or to any one whatsoever, nor applied by the States for any other purpose;

"(*d*) The amount of the loan shall be deposited in the National Treasury or its branches, being delivered as required for liquidations and operations;

"(*e*) All the profits realised on the credit operations or appreciation of the commodity shall be applied to the amortization of the loan;

"Clause 11. The Government is authorised to enter into Agreements with the sugar-producing States of the Union to promote the appreciation of sugar under the same conditions as are embodied in clause 10."

The Revenue Law also contains various other clauses conferring favours on those engaged in sugar-cane raising or sugar production, such as clause 14 of Article 2, sub-clause 1, allowing agricultural instruments and machinery intended for the making and improvement of agricultural productions entry free of duty; sub-clause 7, conceding free entry to material for the construction of sugar mills.

There are other clauses in this law which, although of less consequence than those already cited, would appear to indicate a trend in Brazilian legislation rather to encourage the creation of trade combinations, as sub-clause 9 (*a*), (*b*), (*c*) of clause 14, Article 2, and

Articles 3 and 4, providing exemption from duty and other special fiscal treatment for material when imported by agricultural syndicates and central installations.

It is, however, generally recognised that the provisions of a specially protective nature, embodied in clause 11, will not be put into operation by the Executive, and it is noticeable that, in the Expenditure Law of the same Budget, no provision is made for the opening of the credits necessary for the purpose here contemplated. In short, the opinion is that these special clauses relating to sugar were embodied rather on sentimental than on practical grounds, the inspiring principle being that sugar-producing States should feel themselves, as regards the degree of protection afforded to their industry, on the same footing as their neighbours of the coffee-producing districts.

Reduction of Import Duty.

The same Law contained the following provision with regard to the reduction of the import duty on sugar:—

"Article 1, clause 6. Authorizing the Government to modify the Customs Tariff with a view to reducing the import tax to which foreign sugars are subjected on entry into the country, reducing the present tax to the lowest possible, taking into consideration the variations in exchange rates, so that the home market shall be efficiently protected.

"Sub-clause (*a*). The reduction in the tax shall not apply to sugars produced in countries which allow direct or indirect bounties on their production or exportation.

"(*b*) The Government may alter the new tax if the necessity of defending the home market shall require it."

Assurances were not wanting, from the date of the promulgation of the law, that it was the intention of the Government to proceed in accordance with the lines laid down by this clause, and this section of the law has, in fact, already led to the publication of a decree with the date of the 5th February, 1906, reducing the tax on foreign sugars imported to 200 reis per kilogramme, instead of 1000 reis by previous legislation. Of the new duty of 200 reis, 35 per cent. is payable in gold and the remainder in currency.

This modification, although presumably still providing for a surtax in favour of the home article beyond that allowed by the terms of the Brussels Convention, shows at least the intention of the Brazilian Government to bring the taxation affecting this produce, as far as possible, into line with the conditions applicable in countries forming part of the Convention.

And after consideration of the items regulating the cost of production in this country, on which matter information for the forming of an opinion will be found in the Tables annexed, marked No. 2, it may be judged that the surtax is not in disproportion to what is considered by the Brazilian Government to be required for the effective protection of the home trade, owing to the special conditions of internal taxation; and having regard especially to the inconstancy of exchange, the course of which, as at the present time, frequently assumes most unexpected developments, and which may at any time rise to a level affording advantageous conditions for the introduction of foreign sugars.

SUMMARY OF CONCLUSIONS.

1. That no grants of the nature of a bounty are in operation for the advantage of the sugar trade.
2. That no organization of the nature of cartels is in existence, that all attempts to bring them into operation have up to the present failed, and that none are likely to come into existence in a practical form, more especially during the prevalence of a high rate of exchange such as that at present ruling, or without the assistance of foreign capital, for the introduction of which present conditions are discouraging.
3. That the prices of sugar are independent of the question whether the sugar is intended for consumption in Brazil or for export. The foreign trade is *not* represented by sugars supplied at abnormally low prices with the intention of affording producers the opportunity of recouping their losses or inadequate gains by maintaining excessively high prices for home consumption.
4. That the differences noticeable in certain States between the duties on exports to other Brazilian States and those for foreign markets in favour of the latter may fairly be considered as equivalent to the drawbacks allowed in other countries on their production paying excise duties when those products are shipped abroad.
5. That the surtax provided by the duty on imported sugar at the rate of 200 reis per kilogramme is intended to protect the home market in view of the exceptionally onerous system of internal taxation and the expenses of transport, &c., and particularly having regard to the inconstancy of exchange.

C. B. RHIND.

ANNEX.

Cost of Production of Sugar, including Transport from the Factories to the Shipping Ports.

PERNAMBUCO.

Field Labour.—The cost of field labour ranges from 700 to 900 reis (1·26 fr. to 1·62 fr.) per diem.

Cost of Producing Cane.—The cost of producing one ton of cane and loading it on railway trucks varies from 4,500 reis to 6,000 reis (8·10 fr. to 10·80 fr.), according to distance from the loading point and the nature of the soil.

Purchase Price of Cane.—"Usinas" generally raise part of the cane on their own land, but supplement the supplies by cane bought from other cultivators. The price of cane is regulated by an established system which makes the value of white sugars or "usinas" the starting point for prices, *e.g.*, when these sugars are quoted at 3,000 reis per 15 kilogs. (36 fr. per 100 kilogs.), the price paid for cane is 6,500 reis (11·70 fr.) per 1,000 kilogs., and this price increases or diminishes by 50 reis (9 centimes) per ton of cane for every 100 reis (18 centimes) rise or fall in the price of "usina" sugar per 15 kilogs. The average of the daily quotations during a fortnight determines the price, and the canes are paid for fortnightly on this basis.

Mill Expenses.—The cost of mill labour ranges from 800 to 1,200 reis (1·44 fr. to 2·16 fr.) per day. The ton of cane is reckoned to produce one large bag of 75 kilogs. of sugar, and the following is given as the cost of producing one such bag of sugar. The figures have been supplied by the Usina de Gayanna, and include firewood, oil, waste, wages, and general expenses of the factory during the grinding season. They are, of course, exclusive of the cost of the cane:—

Usina, boa qualidade	1,860	reis per 75 kilogs.
Crystals	1,400	,, ,,
Demeraras	1,150	,, ,,
Bangue	830	,, ,,

Transport to Pernambuco.—The total cost of transport from the factory to the port of Pernambuco may be put at 1,500 reis (2·70 fr.) per bag of 75 kilogs., including the cost of transport to receiving stations.

THE POLARIMETRIC DETERMINATION OF SUCROSE.

By Francis Watts, C.M.G., D.Sc., F.I.C., F.C.S., and
H. A. Tempany, B.Sc. (Lond.), A.I.C.

In a previous paper we discussed the effect of temperature on the polarimetric determination of sucrose, and also the effect of the volume of the lead precipitate produced in the process of clarifying saccharine solutions for optical examination. (See *West Indian Bulletin*, Vol. VI., pp. 52-60.)

In that paper we produced evidence to support the conclusion that temperature exercises such an influence upon the optical activity of sucrose as to render it desirable and necessary to introduce a correction for this effect when working under tropical conditions. (The results there arrived at in this connection were dependent upon the purity of the specimen of sugar upon which the work was performed.)

The paper in question has been the subject of criticism in the *International Sugar Journal* (Vol. VII., pp. 419 et seq., Wiechmann, and pp. 527 et seq., Messrs. H. & L. Pellet). These were followed by an editorial summing-up of the work done by various observers (Vol. VIII., pp. 10 et seq., January, 1906), which concludes with the expression: "Where experts disagree, who shall decide? One subject of dispute may be dismissed in a few words. The influence of temperature on the optical activity of sucrose is a question to be decided by experimental evidence alone. Experts do not express opinions regarding probabilities, but regarding the nature of the evidence brought forward. Where many experimental difficulties exist, criticism is of the greatest value in avoiding errors, and thus ultimately arriving at the truth. We must hope that the investigations now in progress will furnish more definite information regarding this supposed influence of temperature."

In these discussions one valid objection is raised, namely that the correction for temperature proposed by us presupposes that the specimen of sugar used in our determinations was absolutely pure sucrose—a point difficult of proof.

It is possible, however, to devise a method eliminating this objection. To this end it is only necessary to observe the optical activity of a solution of sucrose at two different temperatures and to compare the results. Various corrections have to be made for the effect of temperature upon the quartz wedge of the polarimeter and upon the volume of the solution, but the factors for these corrections have been determined with a high degree of precision.

Unfortunately, this method of solving the problem presents special difficulties in the tropics and was therefore set aside as inapplicable when we were first attacking the question. It is, however, one which can be applied with less difficulty in a cold climate. Accordingly, advantage was taken of the presence of one of us (H. A. T.) in England during last winter to make a series of observations on these lines.

The object in view was to determine, at two widely different temperatures, the polarimeter readings of a solution containing 26 grams of sugar in 100 cc., to make corrections for the effect of temperature upon the volume of the solution and upon the quartz wedge, and to ascertain whether the readings thus corrected revealed any difference; if so, the difference would be held to be due to a change in the optical activity of sucrose consequent upon the change in temperature.

It is to be observed that in this method the purity of the sugar is of little consequence, provided that no large amount of any other substance is present which may also be liable to change of activity with changing temperature: as a matter of fact, the purest obtainable sugar was employed. The observations all being made on one solution, any possible errors in weighing or measuring are eliminated. Minor errors or want of adjustment of the polarimeter do not affect the accuracy, for the point to be observed is only a difference over a very small range of the polarimeter scale, in the case in question about 1° Ventzke.

The experiments were performed in the laboratory of Messrs. Garton Hill & Co., of Battersea, London, whose chief chemist, Dr. L. T. Thorne, and his staff took a lively interest in the investigation and afforded much useful assistance.

A preliminary series of experiments was performed in order to ascertain the best working condition and to ensure everything being in order. The room in which the experiments were performed was a small one, about 10 feet by 10 feet square.

The arrangement for heating the room consisted of two Erlenmeyer combustion furnaces mounted on an iron plate in the middle of the room.

Polarimeter.—The polarimeter used was a white light double quartz wedge compensation instrument, of the half shadow type, by Schmidt and Haensch, and standardized by them.

Polarimeter Lamp.—An ordinary polarimeter lamp for gas was used, with lens, chimney, &c. This lamp was enclosed in a wooden box lined with asbestos card, a circular hole being cut in the side opposite the lens. This was done to obviate any heating effect of the lamp on the polarimeter and tube. With the above arrangement it was found that the temperature remained unaltered during the taking of the readings.

Polarimeter Tube.—The polarimeter tube used was of glass with a tubulure admitting of a thermometer being passed into the liquid. The diameter of the tube was large, about 1½ cm., and the length 220 mm. The capacity of the tube was about 50 cc. The tube had been expressly made for invert sugar determinations by heating, and was quite the most suitable obtainable. The fact that the tube with the cane sugar solution gave a reading greater than 100 did not matter, as the double quartz wedge of the polarimeter permitted of readings higher than 100° V. being obtained.

The tube was fitted with a thermometer, accurately graduated in fifths of a degree Centigrade, which, passing through a tightly fitting cork, obviated any risk of evaporation. The tube was enclosed in a copper air-bath, thus obviating sudden changes of temperature.

Temperature.—The temperature of the solution was ascertained, as already stated, by a thermometer passing into the solution. A second thermometer was placed between the quartz wedges, so as to give as near an indication of the temperature at that point as possible. Both of these thermometers were graduated to read to ·2° C. A third thermometer was placed inside the air bath near the polarimeter tube. Several other thermometers were distributed round the room, so as to enable the average air temperature of the room to be satisfactorily ascertained.

Sugar.—The sample of sugar used in these experiments had been prepared by precipitation from a concentrated aqueous solution by the addition of alcohol. Before using it was kept in an evacuated desiccator for forty-eight hours.

In making up the solution 65 grams of sugar were weighed out, dissolved in distilled water, and the solution made up to 250 c.c. in a graduated flask.

Experimental details and results.—The apparatus, &c., required, having been obtained, the whole was allowed to remain over from Saturday afternoon till Monday morning.

The first thing on Monday morning the sugar solution was made up, as detailed above, at the room temperature (filtered once through Swedish paper), and the polarimeter tube washed out and filled with solution. The remainder of the solution was preserved in a well-stoppered flask in the room in which the experiments were performed. The solution was then polarized.

SERIES I.

Readings in 220 mm. Tube.

				(Zero reset.)
a.	109·8	....	b.	109·9
	109·8	....		109·9
	109·9	.. .		110·0
	109·9	....		109·85
	109·9	....		109·9

Mean = 109·885.

Reduced to terms of 200 mm. tube = 99·898.

Temperature of solution.		Temperature near quartz wedge.	
Initial . ..	16·1°C.	Initial	15·6°C.
Final	16·2°C.	Final	16·4°C.
Mean	16·1°C.	Mean	16·0°C.

After this first series of readings had been taken, the heating of the room was commenced. This, as already stated, was accomplished by means of two combustion furnaces. These were lighted, and the temperature of the air rose rapidly; that of the solution in the tube followed more slowly. The heating was continued till the air temperature stood at about 37°C., the solution then being at about 29°C.; the gas supply was then reduced, and the air temperature allowed to fall slowly, that of the solution continuing to rise slowly. When the temperatures of the air and the solution were approximately coincident, the gas supply was increased, so as to maintain the temperature of everything constant: after this uniform condition had been maintained for ten minutes, the second series of readings was taken.

The entire process of heating up occupied about two hours.

The results obtained were as follows:—

SERIES II.

Readings by H. A. T.			*Readings by L. T. T.*		
		(Zero reset.)			(Zero reset.)
a. 108·8	....	b. 108·9	a. 108·75	....	b. 108·75
108·8	....	108·9	108·75	....	108·8
108·8	....	108·75	108·8	....	108·8
108·75	....	108·8	108·8	..	108·75
108·8	....	108·8	Mean = 108·775.		
Mean = 108·810.					

Mean of all readings .. .. = 108·792

Reduced to terms of 200 mm. tube .. .... = 98·901

Temperature of solution.		Temperature near quartz wedge.		Temperature of air bath.	
Initial ..	32·8°C.	Initial ..	33·0°C.	Initial ..	33·0°C.
Final ..	32·8°C.	Final ..	33·0°C.	Final ..	33·0°C.

After this series of readings had been completed, the tube was emptied and refilled with a fresh portion of solution from the bulk in the stoppered flask, which had been kept in the observation room and thus subjected to the change of temperature, the tube was allowed to stand in the polarimeter for about fifteen minutes so as to ensure uniform temperature conditions, after which a further series of readings was taken with the following results:—

SERIES III.

		(Zero reset.)
a. 108·9	....	b. 108·7
108·7	....	108·8
108·8	....	108·9
108·9	....	108·8
..	....	108·9

Mean = 108·82.

Reduced to terms of 200 m.m. tube = 98·929.

Temperature of solution.		Temperature near quartz wedge.		Temperature of air bath.	
Initial ..	32·7°C.	Initial ..	33·2°C.	Initial ..	32·9°C.
Final ..	32·7°C.	Final ..	33·4°C.	Final ..	33·2°C.

Finally, the polarimeter tube and solution were allowed to stand till the following morning, by which time the temperature had assumed a value approaching nearly to the original, and a further series of readings was taken. These readings were taken by Dr. Thorne and his assistant the following day: H. A. T. was not present when they were taken:—

SERIES IV.

Readings.

a. 109·75	....	b. 109·8	....	c. 109·8
109·75	....	109·85	....	109·85
109·8	....	109·75	....	109·75
109·75	....	109·85	....	109·85
..	....	109·75	....	109·85
..	....	..	....	109·8
..	....	..	....	109·75

Mean = 109·790.

Reduced to terms of 20 mm. tube = 99·809.
Temperature, commencement 17°C.
,, end 18°C. Mean 17·5°C.*

This result is of importance as showing that the lowering observed was not due in any way to inversion.

We thus have the following readings from observations made on a single solution:—

(1) at 16·1°C. = 99·898 | (3) at 32·7°C. = 98·929
(2) at 32·8°C. = 98·901 | (4) at 17·5°C. = 99·809

Consideration of results obtained.—

Four factors must be taken into account in considering the lowering of the polarimetric reading observed with rise of temperature:—

a. Expansion of the sugar solution.†
b. Influence of rise of temperature on the specific rotation of the quartz wedge.
c. Expansion of polarimeter tube.
d. Influence of rise of temperature on the specific rotation of sucrose.

As already stated, we have four sets of readings based on one solution, two at low and two at high temperatures.

These afford four comparisons, namely, the difference between 1 and 2; 1 and 3; 4 and 2; 4 and 3.

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* Temperature near quartz wedge not recorded: it is assumed to have been that of the solution.

† As the expansion of the sugar solution with the rise of temperature has an important influence upon the observed readings, it was deemed desirable to determine exactly the co-efficient of expansion of a sugar solution containing 26 grams per 100 cc. through about the same range of temperature as that observed while making the polarimeter readings. This was found to be ·00029 per degree Centigrade.

The method adopted was that of the "weight thermometer," with precautions to prevent evaporation during weighing. In order to ensure accuracy, a large volume of solution was employed. The following results were obtained:—

	Grams.
Weight of vessel and solution at 16·5°C.	254·4514
Weight of vessel	76·8528
Weight of solution at 16·5°C.	177·5986
Weight of vessel and solution at 28·0°C.	253·9076
Weight of vessel	76·8528
Weight of solution at 28°C.	177·0548
P = Weight of solution at 16·5°C·	
p = difference between weight at 16·5°C. and 28°C.	·5438
P − p = weight of solution at 28°C.	
= difference of temperature, or 11·5°C.	

$$\text{Apparent expansion} = \frac{p.}{(P-p)\,t} = \frac{\cdot5438}{177\cdot0548 \times 11\cdot5}$$
$$= \cdot0002677$$

To this must be added the co-efficient for the expansion of glass in order to obtain the real co-efficient of expansion of the solution.

Apparent expansion of solution	·0002677
Expansion of glass	·0000258
	·0002935

Whence the co-efficient of expansion per degree Centigrade of a solution of sucrose containing 26 grams per 100 cc. is taken at ·00029, a figure agreeing with that given by Landolt.

Taking the comparisons between series 1 and 2, we find as follows:—

A rise of temperature of 16·7° for the solution and 17·0° for the quartz wedge. This is accompanied by a lowering of the polarimeter reading of ·997°V.

		Degrees V.
Correction for expansion of liquid ·00029 × 16·7 × 98·901	=	+·479
Correction for temperature quartz wedge (Jobin) ·00016 × 17 × 98·901	=	+·269
Correction for expansion of polarimeter tube ·0000086 × 16·7 × 98·901	=	—·014
		·734

	Degrees V.	
Observed difference	·997	
Difference accounted for by corrections	·734	
Difference accounted for by sucrose	·263	
Whence the difference due to 1°C. is		·0157

Taking next the comparison between 1 and 3—

We have a difference of temperature of 16·6°C. for the solution and 17·1°C. for the quartz wedge, with a difference of ·969°V. in the polarimeter readings.

		Degrees V.
Correction for expansion of liquid ·00029 × 16·6 × 98·929	=	+·476
Correction for temperature quartz wedge (Jobin) ·00016 × 17·1 × 98·929	=	+·271
Correction for expansion of polarimeter tube ·0000086 × 16·6 × 98·929	=	—·014
		·733

	Degrees V.	
Observed difference	·969	
Difference due to corrections	·733	
Difference due to sucrose	·236	
Whence difference for 1°C. is		·0142

Taking next the comparisons between 3 and 4—

We have a difference of temperature of 15·2°C. for the solution and 15·7 for the quartz wedge, with a difference of ·88°V. in the polarimetric reading.

		Degrees V.
Correction for contraction of liquid ·00029 × 15·2 × 98·929	=	+·436
Correction for temperature quartz wedge (Jobin) ·00016 × 15·7 × 98·929	=	+·248
Correction for expansion of polarimeter tube ·0000086 × 16·7 × 98·901	=	—·013

	Degrees V.	
Observed difference	·880	
Difference due to corrections	·671	
Difference due to sucrose	·209	
Whence difference due to 1°C. is		·0138

Taking, finally, series 2 and 4—

We have a difference of temperature of 15·3 for solution, and 15·5°C. for quartz wedge, with a difference of ·908 in the polarimeter readings.

	Degrees V.
Correction for expansion of liquid ·00029 × 15·3 × 98·901	= +·439
Correction for temperature quartz wedge (Jobin) ·00016 × 15·5 × 98·901	= +·245
Correction for expansion of polarimeter tube ·0000086 × 16·7 × 98·901	= —·013
	·671

	Degrees V.	
Observed difference	·908	
Difference due to corrections	·671	
Difference due to sucrose	·237	
Whence difference due to 1°C. is		·0155

Thus for this sugar solution which at 16·1°C. polarizes 99·9, we get the following four figures as a temperature co-efficient for change of rotation per degree C. in degrees V.:—

	Degrees V.
a.	·0157
b.	·0142
c.	·0138
d.	·0155
Mean	·0148

We may therefore state the formula for the correction for the effect of temperature on sucrose as (·000148 t) N, where t is the difference between the observed temperature and 17·5°C., and N the observed polarimeter reading; or, combining this with the correction for the effect of temperature on the quartz wedge (Jobin), and on the polarimeter tube, (·00032 t) N.

This correction for the effect of temperature on sucrose as found by this new series of observations is smaller by ·00007, or about one-third, than that previously found, but we think that these observations, from which any question as to the purity of the sugar employed is eliminated, remove any doubt as to the fact that change of temperature does affect the optical activity of sucrose, and that it is desirable and necessary to introduce a correction for this when working under tropical conditions.

The difference between the result now obtained and that deduced from our previous experiments may doubtless be regarded as caused partly by errors of observations, inherent in work of this kind, and partly by a trace of impurity in the sugar employed.

We desire to express our sincere thanks to Messrs. Garton Hill & Co. for the use of their laboratory, and to Dr. Thorne and his staff for their kind interest and assistance, without which the work could not have been carried out.

In conclusion we may point out that the results now put forward by us are in very close agreement with those of Wiley and of Schönrock.

Wiley (*Jour. Amer. Chem. Soc.*, 1899, 21, pp. 568-96. Abstract in *Jour. Chem. Soc., Lond.*, 1899, A ii, p. 702) puts forward results from which the correction to be applied on account of the change of optical activity of sucrose with change of temperature is ·00016 per degree Centigrade for each degree V., the solution being polarized at the temperature at which it is made up. To this must be added the correction for the temperature of the quartz wedge, ·00016, making a total correction of ·00032.

Schönrock, who appears to have been provided with appliances of the greatest accuracy, and who bases his work on observation made both by means of "polariscopes" and "polarimeters," gives as his latest results (*Zeit. Ver. deut. Zucker Ind.*, 1903, 569, pp. 650-3) the following :—

"In practice, if a normal sugar solution is made up at 20°C. but polarised at t° in a saccharimeter, the quartz wedge compensator of which is also at t°, the reading Ventzke must be increased by 0·061 (t-20) in order to obtain the true hundred point of the scale at 20°" (*Jour. Chem. Soc., Lond.*, 1903. Abstracts ii., p. 764). This correction includes that for the expansion of the solution with change of temperature and for the lengthening of the saccharimeter tube, corrections which, as stated in our work, amount to ·030. If we deduct this we find Schönrock's correction, applicable to a solution when polarized at the temperature at which it is made up, amounts to ·061 — ·030 = ·031 (t-20) when the saccharimeter reads 100°V., which is in agreement with our results.

Wiley's correction .... .. = Pol. + (·00031t) N.
Schönrock's ,, ... = Pol. + (·00031t) N.
Watts and Tempany, present result .. .. = Pol. + (·00032t) N.

Therefore, having regard to the conditions conducing to accuracy under which Schönrock's work was performed, and considering the practical identity of our own and Wiley's results with his, we now suggest the adoption of the following correction for temperature :—

Polarize at the temperature at which the solution is prepared, and correct for temperature by the formula, polarization + (·00031t) N, where t is the difference between the temperature of observation and that at which the instrument was standardized, and N is the Ventzke scale reading.—(*West Indian Bulletin.*)

ESSAY ON THE INFLUENCE OF LEAD PRECIPITATE IN THE ANALYSIS OF SUGAR PRODUCTS.*

By H. Pellet.

In the order of the day for the meeting of the 4th of August, 1906, the following question occurs:—

How to avoid the error due to lead precipitate in sugar analysis by the optical method. Reporter, Dr. Wiechmann.

Allow me, gentlemen, to acquaint you with the result of new researches made on this subject, which, I trust, will enable us to adopt the conclusions which I shall place before you.

Without giving a detailed history of the papers which have been published on the question, I must, however, remind you of the conclusions which have been arrived at by different authors. I will classify them in three groups:—

Those who affirm the influence of the lead precipitate.

Those who deny the influence of the lead precipitate in every case.

Those who deny the influence of the lead precipitate in most cases, but admit it in the case of certain products, notably raw beet juice.

Those who affirm the influence of the lead precipitate in all cases.

In the first place, I must mention Welz in 1867; Maumené in 1869; Scheibler in 1875; Nebel and Sostmann in 1876; Champion and Pellet in 1876; Lenoble in 1895. Then more recently in 1903, at Berlin, Dr. Wiechmann points out the influence of lead precipitate in cane sugar analyses; and lastly, Dr. Horne has again pointed out this influence, and suggested, in order to avoid it, the use of solid tribasic sub-acetate.

Those who deny the influence of the lead precipitate in all cases.

First there was Raffy in 1874; then Commerson and Laugier in 1876, also in 1883; Pellet and Biard also in 1883; Moor in 1894; Pellet in 1897; Weisberg in 1899; Gonnermann, Vermehren and Molenda in 1903-4.

Those who deny the influence of the lead precipitate in most cases, but admit it in the case of certain products, such as raw juices.

F. Sachs in 1880; F. Sachs and de Barbieri in 1884.

In order to demonstrate the influence of the lead precipitate, several methods have been employed.

First the method of double polarization, which is liable to many causes of error, especially at the time it was employed, the saccharimeters being far inferior in sensibility to those now used.

Then the method which consists in determining the weight of lead precipitate, and its density, and calculating the volume occupied by this insoluble precipitate. This method is fundamentally wrong, for one has to assume that the lead precipitate does not retain any sugar, or the reverse possibility, *i.e.*, that the precipitate does not absorb water in becoming hydrated, thus increasing the richness of the sugar solution.

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*Read to the Members of the International Commission for Uniform Methods of Sugar Analysis at its Session, August, 1906, and specially translated by this Journal.

On the other hand, those who have studied the direct influence of lead precipitate, maintain that a certain quantity of sugar is absorbed by the precipitate during its formation, thus neutralising any influence of the insoluble matter.

Lastly, Messrs. Sachs and de Barbieri are the only authorities who deny the influence of the lead precipitate in all cases; not because it absorbs sugar, but because, when sub-acetate of lead is used, sufficient acetate of potash is formed to diminish the polarization of the sugar and thus to neutralize the influence of the precipitate. However, they make one exception, namely, raw beet juice, because the probable liberation of acetic acid would destroy the action of the acetate of potash and leave the error due to the lead precipitate undiminished.

Personally, we agreed with these conclusions for a considerable time; but since 1897, we have abandoned them as the result of our experiments on the analysis of raw beet juice.

In fact, the question of the influence of lead precipitate has once more been raised owing to the essays of Drs. Wiechmann, of Brooklyn, and W. D. Horne, of New York.

I have taken up the question again with several of my colleagues, and the following are the results of new experiments, which enable me to draw the following conclusions.

As regards the opinion expressed by Messrs. Sachs and de Barbieri, I have made experiments as to the influence of acetate of potash on pure sugar solutions, and have not detected any such influence even when two grammes of this salt were added to the normal weight of sugar corresponding to my saccharimeter, a most sensitive one.

Consequently, as these gentlemen found that the lead precipitate exercises no influence, we are forced to admit that, in their experiments, this precipitate entrained some sugar. This, moreover, is the general conclusion of all those who have worked under the best possible conditions.

The lead precipitate has no influence on the saccharine richness of solutions in which it is formed, whatever may be the nature of these solutions: raw juice, purified juice, syrups, masses-cuites, rich and poor molasses, &c., in the case of beet products. On the other hand, its influence, if it has to be taken into account, is additive rather than subtractive, but in any case very slight.

As regards cane products, sub-acetate of lead must never be used for defecation when an exact analysis is required as this re-agent precipitates some of the levulose, thereby increasing the dextro-rotative power of the remaining sugars. For the exact polarization of cane products, Clerget's method alone should be used; defecation being effected either by neutral acetate of lead, or by calcium chloride (Zamaron).

In studying the influence of the lead precipitate on the analysis of saccharine products, conclusions should not be drawn from the influence of precipitates of a totally different nature.

It has been practically demonstrated that certain precipitates do not at all resemble the precipitate formed in raw beet juice (*vide* Raffy, Scheibler, Gillot, and Grosjean.)

This led my son, M. Léon Pellet, and myself to study this question by separating the lead precipitate from raw beet juice (a considerable quantity being obtained during the campaign) and decomposing same with sulphuretted hydrogen. The organic matter thus separated was added to sugar solutions in the same proportion as it is at present in raw beet juice. These solutions were then defecated with sub-acetate of lead and polarized. In spite of the presence of a notable proportion of lead precipitate, no increase in the polarization was detected.

The following are the new experiments to which I have alluded :—

In order to magnify the influence of lead precipitate, I operated on:

(1.) Beet molasses;

(2.) Raw beet sugar of low polarization.

Possessing a very sensitive and verified saccharimeter, I wished to see what results the Scheibler method of double dilution would give. For this purpose a 40% solution of molasses was prepared.

(1.) 50 cubic centimetres of the solution required 22 cc. of sub-acetate of lead to precipitate all the organic matters; the mixture being diluted to 100 cc.

The mean of ten polarizations in a verified 200 mm. tube gave :—

	Experiment No. 1.		Experiment No. 2.
Polarization	50·40	..	50·38
Average	..	50·39	..

(2.) Repeating the test but diluting to 200 cc. and polarizing in a 400 mm. tube :—

	No. 1.		No. 2.
Polarization	50·42	..	50·42
Average	..	50·42	..

Weight of the dry lead precipitate in 50 cc. of solution (or 20 grammes of molasses) = 3·275 gr.

My son, Léon Pellet, used the following new method of studying the influence of the lead precipitate :—

To 50 cc. of the same solution of molasses he added 22 cc. of sub-acetate of lead and a little distilled water, collecting the precipitate on two tared filters.

When 20 cc. of the filtered liquid had been collected, the precipitate was washed until quite free from sugar, the washings being made up to 200 cc.

The 20 cc. portion was polarized in a 400 mm. tube and the dilute portion in a 600 mm. tube, with the following results (averages of eight polarizations) :—

	1st Trial.	2nd Trial.
(*a*) Original filtrate	50·04	50·35
(*b*) Dilute washings	0·40	0·15
Total	50·44	50·50
Mean	50·47	

It is therefore evident that the precipitate formed in the original volume of 100 cc. has diminished rather than increased the polarization. Also, that if the lead precipitate absorbs sugar, the latter is separated by washing, as has also been recognised by Dr. Horne.

On a sample of sugar having the following composition :—

Polarization	92·44
Ash	2·12
Water	1·64
Organic matter	3·80
Total	100·00

there were obtained by the Scheibler method :—

20 grammes of sugar in	100 cc.	100 cc.	
Average of 7 polarizations	92·407	92·436	
20 grammes of sugar in	200	200	200
Average of 7 polarizations	92·53	92·44	92·40
Average polarization when diluted to 100 cc. =	92·42	cc.	cc.
Average polarization when diluted to 200 cc. =	92·46		

The difference is very slight, and in the same direction as with molasses.

Care was of course taken that the temperature remained constant (at 15° C.) during the experiments.

M. L. Pellet obtained similar results when examining the same samples of sugar by his method.

I now pass to the results of my experiments with cane products, selecting molasses for the same reason as before, namely, that if there is no error when the lead precipitate is large there can be none when it is small, as in the case of cane sugars.

M. L. Pellet repeated the estimation of the sugar in the clarified and filtered solution as well as in the washings of the precipitate. The results were absolutely the same as in the case of beet molasses; there being no influence of the lead precipitate. Sub-acetate of lead was employed in this experiment in order to compare the results obtained with and without the influence of the lead precipitate; this being all that was to be demonstrated.

Now, how has Dr. Wiechmann calculated the influence of the lead precipitate in cane sugar analyses? Solely from the weight of the precipitate formed, its density, and its volume.

From 20 different samples of sugar, he calculated an average error due to the lead precipitate of + 0·44 (variations from 0·05 to 0·98).

Dr. Horne has published tables, showing considerable errors in the polarization of cane sugars due to the influence of the lead precipitate.

As the result of his experiments, he claims that when dry sub-acetate of lead is employed in small quantities as a clarifying agent, correct polarizations are obtained; these being always lower than the polarization of the same sugars after clarification by the ordinary method.

But in a recent memoir presented to the Sixth International Congress of Applied Chemistry (held at Rome in April-May, 1906) dealing with the analysis of refinery products, the author discovers a strange fact, namely, that ordinary clarification, which he distinguishes as "wet," gives practically the same results as his "dry" method; the differences being from 0 to 0·10 at most for widely different products.

Taking an example, probably of exhausted molasses:—

Polarization after wet clarification	28·16
Polarization after dry clarification	28·20
Difference....................	0·04

In view of such results obtained with an impure syrup, clarified by the addition of a large quantity of sub-acetate of lead, how is it possible for the author to maintain his conclusions regarding the errors in the analysis of sugars when the quantity of lead precipitate is insignificant? The author himself is perplexed by these results, and can find no explanation.

Let us turn to M. Fribourg's experiments in the same direction. After having acquainted himself with the particulars published by Dr. Horne, M. Fribourg prepared an average sample of cane sugar polarizing 97°, and with it carried out a large number of tests (in duplicate or triplicate) with the utmost care, in order to obtain comparative results.

Six times the normal weight of sugar were dissolved and made up to 300 cc., and of this solution several portions, measuring 50 cc, were treated successfully with 1, 2, 3, and 4 cc. of the liquid reagent, and with the undermentioned weight of Horne's dry reagent. In each case the clarified solution was diluted to 100 cc. and the reading observed in a 400 mm. (200 mm.?) tube giving the polarization direct.

He employed as clarifying agents: –

(1.) Neutral acetate of lead;
(2.) Sub-acetate of lead (Courtonne's formula);
(3.) Horne's dry sub-acetate of lead.

With cc.	Neutral acetate.	Liquid sub-acetate.
1	97·13	96·95
2	97·40	97·37
3	97·40	97·52
4	97·40	97·52

With gr.	Horne's dry sub-acetate.
0·350	97·15
0·700	97·20
1·050	97·35

It will be seen:—

(1.) That the polarization increases proportionately to the volume of liquid sub-acetate added.

(2.) That with neutral acetate of lead the polarization is similar to that with Horne's dry sub-acetate, when both reagents are employed in small quantities.

(3.) That as the quantity of Horne's dry sub-acetate is increased, so also is the polarization.

In our opinion, these variations are due to the fact that sub-acetate of lead precipitates some of the levulose, thereby modifying the optical rotation due to the remaining levulose (and dextrose?). Consequently any excess of dry sub-acetate of lead is less objectionable.

But is the lowest polarization necessarily the correct one? I think not, and for the following reason:—The laevo-rotatory power of the reducing sugars present tends to diminish the polarization to an extent which may be important, according to their amount.

This is also proved by M. Fribourg's experiments on the estimation of crystallizable sugar by Clerget's method.

In passing, I may state that M. Fribourg has re-determined the factor for calculating invert sugar formed per 100 parts of sucrose, under the conditions of his experiments.

On impure cane sugar, he obtained by the Clerget method:—

With cc.	Neutral Acetate.	Liquid Sub-acetate.
1	97·36	97·14
2	97·53	97·47
3	97·56	97·62
4	97·53	..

With gr.	Horne's Dry Sub-Acetate.
0·350	97·37
0·700	97·37
1·050	97·45

Giving a mean result of 97·44 by Clerget's method. The variations from 97·14 to 97·62 may be attributed, in our opinion, mainly to the small errors of measurement. Taking the differences in the polarization before and after the Clerget inversion we find:—

With cc.	Neutral Acetate.	Liquid Sub-Acetate.
1	+0·23	+0·19
2	+0·13	+0·10
3	+0·16	+0·10
4	+0·13	..

With gr.	Horne's Dry Sub-Acetate.
0·350	+0·22
0·700	+0·17
1·050	+0·10

It will thus be clearly seen that, in proportion as the quantity of the re-agent is increased, the difference between the two polarizations by Clerget's method diminishes. This is well known to chemists employed in cane sugar factories. Consequently, by increasing the proportions of the re-agent still further, a point would be reached where the difference between direct polarization and Clerget polarization would disappear.

This explains why the same polarization is often obtained with cane products before and after inversion, and also accounts for the observed variations in the rotatory power of reducing substances as calculated from the difference in polarization before and after inversion, thus giving rise to the belief that the reducing sugars present in cane products are optically inactive.

These and many other experiments indicate that the true polarization of cane sugars is not obtained when the solutions are clarified with sub-acetate of lead, dry or liquid; still less in the case of neutral acetate of lead, but only by Clerget's inversion, which Drs. Wiechmann and Horne appear to have lost sight of. The sugar used by M. Fribourg contained from 0·70 to 0·80 of reducing matter, and it is therefore not astonishing that the direct polarization was short of the truth by 0·19 to 0·23, or an average of 0·21.

For this reason I agree with M. Fribourg's proposal that cane products should be analysed solely by Clerget's method, as follows:—

(1.) *Moisture.*—Small percentages to be estimated by drying the sugar direct. In the case of very moist sugars, a weighed quantity to be dissolved in a little water, the solution poured over a weighed quantity of pumice-stone sufficient to absorb it, and the whole dried to constant weight.

(2.) *Ash* by the ordinary method. The insoluble (suspended) matter which may amount to as much as 5, 10, or 40% of the mineral matter being also estimated.

(3.) *Crystallizable Sugar.*—By Clerget's inversion, the solution being clarified by means of calcium chloride (Zamaron) and a little neutral acetate of lead.

(4.) *Reducing Sugar.*—On a solution of the sample without addition of clarifying agents, the reduction with copper solution being effected on a boiling water bath, and the copper oxide weighed after ignition in a muffle furnace.

The above-mentioned sample of sugar was re-analysed by these approved methods, with the following results:—

	First Analysis. Apparent Composition.	Second Analysis. True Composition.
Sucrose	97·40	97·54
Reducing substance	0·750	0·815
Ash	0·642	0·642
Moisture	·255	·255
Organic Matter	0·953	0·748
	100·00	100·00

There is no reason why the methods of analysis applicable in the case of cane sugars should not be equally applicable to the impure products of the cane factory.

In the case of cane molasses it is known that there are considerable differences between the "apparent" and "true" compositions, as shown in the following examples of cane molasses obtained in Egypt during the 1905-06 campaign.

Ordinary treatment of the juice:—

	Apparent.	Actual.
Water	11·85	19·89
Polarization	32·45	39·10
Reducing sugars	17·68	18·26
Ash	10·25	10·25
Organic matter	27·77	12·50
	100·00	100·00
Brix	85·15	80·11

Special treatment of the juice:—

	Apparent.	Actual.
Water	10·00	19·14
Sugar	37·80	39·97
Reducing sugars	12·26	15·94
Ash	12·73	12·73
Organic matter	27·21	12·22
	100·00	100·00
Brix	90·0	80·86

Consequently, in the analysis of raw cane products of varying degrees of purity, we arrive at the conclusion that the error due to the volume occupied by the lead precipitate may be entirely ignored when clarifying with sub-acetate of lead in the ordinary way; but that for the estimation of crystallizable sugar accurate results can only be obtained by Clerget's method, wherein the use of sub-acetate (liquid or solid) is dispensed with. The polarization after inversion will be higher than the direct polarization in proportion as the purity of the material examined decreases.

This we have proved is the case of second and third jet sugars, containing from 3% to 6% of reducing sugars, and which by Clerget's test are found to contain 1% to 2·5% more sugar than by direct polarization, as in the following examples of low-grade second sugars:—

	Apparent Per cent.	Actual Per cent.
Water	0·82 to 1	4·00 to 4·10
Crystallizable sugar	81 to 82	82 to 83·50
Reducing substances	2·90 to 3·00	3·8 to 4
Soluble ash	4·5 to 4·6	4·5 to 4·6
Insoluble ash	0·20 to 0·50	0·20 to 0·50

It follows, then, that the *true* composition of a sample of cane sugar is sometimes widely different from the apparent composition as indicated by the usual methods of analysis.

And the general conclusion to be drawn from our experience of the last thirty years is that the efficient control of a cane sugar factory or refinery is only possible when the analyses are made by the method which we have repeatedly advocated, and which alone enables us to record the actual weight of sucrose, reducing sugars, and organic matters passing through the factory.

Gentlemen, After the explanation which I have had the honour to place before you I venture to ask your approval of the following conclusions:—

1. In the case of beet products generally, the polarization requires no correction for the volume occupied by the lead precipitate (*vide* Raffy, Gommerson and Laugier, Pellet and Biard, Sencier, Pape, Weisburg, Gonnerman, Vermehren, Mollenda, Neumann, Gillot, Grosjean, Pellet and L. Pellet).

2. The lead precipitate absorbs and carries down a certain quantity of sugar, thus neutralizing the error caused by the volume of the precipitates.

3. For accurate analyses of products of cane sugar factories, neither the solid nor the liquid sub-acetate of lead should be employed.

4. The true polarization of the products of cane sugar factories can only be obtained by Clerget's inversion method; using calcium chloride (Zamaron), and neutral acetate of lead for decolorizing and

clarifying the solutions for optical analysis (as also for the estimation of the reducing substances).

5. The Clerget polarization generally gives higher results than the direct polarization; the difference being greater in proportion to the amount of reducing substance present.

6. Finally, for all products of cane sugar factories only those methods should be used which indicate the *true* and not the *apparent* composition; the latter being widely different to the former.

It is only by the adoption of uniform methods that we can hope to obtain similar results when the same products are analysed by different chemists, yet the foregoing conclusions are completely at variance with those of Drs. Wiechmann and Horne, who are connected with important sugar refineries in New York.

I am entirely at the disposal of my colleagues for the purpose of experimentally demonstrating the accuracy of the process I advocate for the analysis of all products of the sugar industry whether raw sugar or molasses.

Concerning the "yields" of refined sugar, as calculated from the proportion of mineral matter, only the soluble ash need be taken into account since the ash of certain raw sugars may contain 5, 10, or even 30% of insoluble matter without affecting the yield of refined sugar.

As regards the influence of the insoluble matter on the polarization of raw sugars, Dr. Horne has proved this to be too small to call for any correction. Nevertheless, where special accuracy is required, the weight and volume of this insoluble matter and its influence on the polarization may be easily and accurately determined.

With reference to the use of sub-acetate of lead for clarifying saccharine products, more especially molasses, previous to analysis by Clerget's method, we would suggest that the quantity of re-agent to be used should not be definitely decided by the International Commission but be left to the judgment of the chemist; it being easy to find out what quantity of lead re-agent is required to eliminate all organic matters without adding such an excess of the re-agent as would prove objectionable during the subsequent analysis.

As a matter of fact, when a fixed volume of this re-agent is used, (as is recommended in certain tests carried out by the workmen in French sucreries) it frequently happens that an excess of the re-agent is used, since the volume added and the density of the re-agent are adjusted for the complete precipitation of the organic and mineral impurities present in a normal-weight solution of products which are highly concentrated and impure. When the same volume of reagent is used for clarifying products which are either much diluted or have saline co-efficients of less than 5%, the excess of lead present in the solution may diminish the laevo-rotation by reducing the action of the hydrochloric acid.

This sufficiently explains certain differences, (which have come to our notice during the last campaign) between the analytical results of the fabricants and the distillers when testing identical samples of molasses.

The adjustment of the quantity of re-agent to clarify any solution offers no difficulty to those accustomed to this work, even when the solutions are highly coloured; it being easily seen whether a further addition of the re-agent produces a slight precipitate or none at all. On repeating the clarification of the same solution several times, one perceives that the volume of re-agent added varies within narrow limits, and thereby serves as a rough measure of the impurities present in the solution. Thus, in controlling the work of the malaxeurs we may be impatient to learn whether the exhaustion of the mother-lquor is proceeding regularly. But, since the products obtained have approximately the same composition, when the work is regular it follows that the lowering of the purity will be indicated by an increase in the volume of lead re-agent necessary to clarify the material taken for analysis.

This indication is so valuable that we even prepared a table by means of which the approximate purity of a solution could be ascertained from the amount of sub-acetate of lead required to clarify same, thus indicating at once whether the product of the malaxeurs was normal or otherwise.

AUSTRALIA.

The Sugar Production, 1904–05.

We are indebted to the Editor of the "Year Book of Australia" for an advance proof of the section devoted to the sugar industry, from which we take the following particulars.

The future of sugar production in Northern Queensland remains in considerable doubt, by reason of the expressed determination of the Federal Government to enforce the law prohibiting the employment of coloured labour after the close of 1906. In the southern portions of the State, also in the northern rivers districts of New South Wales, the sugar industry will not materially be affected by the disappearance of the kanaka. It is in these portions of the Commonwealth that the bonus offered by the Federal Government for sugar grown by white labour has been most effective, as shown by the subjoined table relating to the areas registered for bonus and number of white canegrowers in Queensland:—

	1902. Growers.	1902. Acres.	1905. Growers.	1905. Acres.
North	36	1,882	124	5,024
Central	519	12,333	977	28,522
Southern	617	17,814	937	30,471
Extreme South	249	4,509	643	8,589
Totals	1,521	36,538	2,681	72,606

The actual position, therefore, according to Dr. Maxwell, the Queensland Government sugar expert, is: "That after four years' operation of the bonus approximately one-third of the sugar crop of Queensland is produced by white labour. In connection with this summary result it has to be repeated that the progress has taken place almost wholly within the southern and central districts, which are the districts of densest settlement and of the more temperate climatic conditions. . . . At this time there still remain areas which furnish two-thirds of the total sugar crop of Queensland, and which are awaiting conversion from coloured to white conditions of production. These remaining black sugar areas are in the hands of 750 large growers, and are occupied by farmers in the northern districts, and by plantation owners in the southern or Bundaberg district."

As two-thirds of the Queensland sugar production still is obtained by coloured labour, the question is naturally asked as to what will be the position of the industry in 1907, when its employment has become illegal? In 1904-5 there were, in addition to 2,807 kanakas, 3,917 Chinese, Japanese, and other aliens employed; and it is probable that, after the kanakas have become deported, their places will be taken by other aliens, who are, and must remain, outside the conditions of white production. "The existence of this latter class of producers," says Dr. Maxwell, "not only allows of competition to the immediate injury of white labour, it threatens the position of the white farmers by producing upon terms that European standards of living and civilisation are not prepared to accept. If this class of labourer should increase there must gradually grow up in the northern districts conditions and organisations that may not only usurp the areas proposed for European settlement, but which can ultimately infringe upon European institutions, and cause a grave menace to Imperial concerns."

Towards the end of the Commonwealth session of 1905 the Federal Senate made certain alterations in the Sugar Bounty Bill, which would have the effect of reducing the amount of bonus and preventing its renewal after the period specified in the Act had terminated. Should the amendments, which have been adopted by the Federal Government, despite the angry feeling created among Australian sugar-growers, not be modified during the session of 1906, the whole industry will experience a severe check, the time allowed for the operation of the bonus being insufficient to admit of the changes necessitated by the employment of white labour alone. The Queensland Premier declared that the action of the Federal Senate had struck a vital blow at the Queensland sugar industry, which was worth as much to his State as the whole dairying industry was to Victoria.

Everything depends, however, upon the possibility of making life in the northern districts more endurable for the white sugar-growers, especially those whose operations are on a limited scale. Experience has shown that this can be done, if the white settlers endeavour to adapt themselves to existing climatic conditions. They must learn to dispense with the galvanised iron houses to which they were accustomed in the south, and dwell in cooler habitations; consume less meat and more vegetables and fruit; and adopt a lighter costume. In fact, their whole habits must be changed.

NEW SOUTH WALES.

In the mother State the coloured labour difficulty has no place, although a few Asiatics are occasionally found employed. At times kanaka labour was not unknown, the "boys" being Polynesians who had fulfilled their contracts in Queensland, and preferred remaining and earning wages on their own account to returning to the Islands. The industry is confined principally to the extensive and luxuriant districts watered by the Richmond, Tweed, and Clarence rivers, the soil and climate of which are admirably adapted for the purpose. In New South Wales the cane is cut every second year, while in Queensland a crop is annually obtained from the greater portion of the cane-growing area. This explains both the difference in the yields of the two States and the larger apparently unproductive area in New South Wales. In the latter State the cost per ton of harvesting by white labour has been estimated as follows:—Cutting, 3s. 3d.; carting to riverside, 1s.; transfer to mills, 9d.; sundry expenses, 3d.; total, 5s. 3d. The average price for standing cane is 11s. 3d. per ton. This makes the total cost 16s. 6d. per ton. The history of the industry in the State will be found epitomised in the accompanying table:—

Production of Sugar Cane in New South Wales, 1894-5 to 1904-5.

Year.	Area.			Production of Cane.
	Productive. Acres.	Non-Productive. Acres.	Total. Acres.	Tons.
1894-5	14,204	18,705	32,909	264,254
1895-6	14,398	18,529	32,657	207,771
1896-7	18,194	12,859	31,053	320,276
1897-8	12,936	12,929	25,865	269,068
1898-9	14,578	10,181	24,759	289,206
1899-1900	9,435	13,082	22,517	170,509
1900-1	10,472	11,642	22,114	199,118
1901-2	8,750	12,019	20,609	187,711
1902-3	8,899	11,402	20,301	183,105
1903-4	10,405	9,814	20,219	227,511
1904-5	9,772	11,753	21,525	199,640

The number of sugar mills has decreased from 24 in 1895-6 to six in 1904-5, but the amount of horse-power employed—3,146—shows little diminution, showing that the smaller establishments have become absorbed by the larger ones. The output during the year was 400,150 cwt. of sugar, and 1,296,590 gallons of molasses; against 435,718 cwt., and 1,236,702 gallons during the previous year. The estimated value of the plant employed was £509,127; employing 643 hands. There is a large sugar refinery in Sydney employing 390 hands, the quantity of refined sugar milled during 1904 being 1,276,820 cwt. The value of the plant, &c., is estimated at £371,128. The establishment is owned by the Colonial Sugar Refining Company, which takes the greater portion of the sugar cane raised in Australia and Fiji, the prices being arranged with the growers at the commencement of each season.

Of the future of the industry little can be said, but, as already mentioned, the existing proportions may be maintained under favourable circumstances, although the rapid progress of the dairy farming industry may prevent any considerable expansion.

QUEENSLAND.

The subjoined table shows the progress of the industry since 1890-1, when its possible future importance became recognised:—

Progress of Sugar Production in Queensland, 1890-1 to 1904-5.

Year.	Number of Sugar Mills.	Acres of Sugar Cane Crushed.	Sugar Manufactured. Tons.	Molasses Manufactured. Gallons.
1890-1	110	39,435	69,983	1,640,662
1891-2	68*	36,821	51,219	No return
1892-3	72*	40,572	61,368	1,343,281
1893-4	61*	43,670	76,146	269,162
1894-5	62*	49,839	91,712	956,276
1895-6	64*	55,771	86,255	1,730,591
1896-7	63*	66,640	100,774	2,195,470
1897-8	63*	65,432	97,916	2,364,020
1898-9	62*	82,391	163,734	3,998,286
1899-1900	58*	79,435	123,289	3,092,571
1900-1	58*	72,651	92,554	3,534,832
1901-2	52*	78,160	120,858	3,679,952
1902-3	43*	59,102	76,626	2,217,738
1903-4	39*	60,375	91,828	2,407,652
1904-5	53*	82,741	147,688	4,491,407

It will be seen that the output in 1904-5 was the best, with one exception, ever experienced in the State. The quantity grown and harvested by white labour represented 25,876 acres, and 379,884 tons of cane, on which a bonus of £85,211 was paid. In 1902-3 the figures were:—Sugar cane 105,303 tons, bonus £24,540; 1903-4, sugar cane

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* Mills crushing cane only not included.

221,776 tons, bonus £50,454. There were employed in the treatment of sugar and its products during 1904-5, in addition to the 53 mills above mentioned, two refineries and four juice mills, the whole employing 2,296 hands, and representing an estimated value of £1,954,920 in plant, and £165,539 in land and premises, or £2,120,459 in all.

The increased production occasioned by the establishment of the bonus system may possibly become affected by the legislative suppression of Polynesian labour at the close of 1906, and the threatened abolition of the bonus system. It should be explained that under the provisions of a Federal Government measure, entitled the Pacific Island Labourers' Bill, a limited number of Pacific islanders were allowed to enter Australia up to the 31st day of March, 1904, but on and after that date their coming became prohibited. All agreements for their employment terminate on the 31st December, 1906, and after that date any Pacific islander found in Australia will be deported. On the 1st December, 1904, there were 7881 islanders in Queensland. The duty on imported cane sugar is £6 per ton, while the excise duty is fixed at £3 per ton, but a bounty of 4s. per ton of cane (equal to £2 per ton of sugar) is allowed on Australian sugar grown by white labour, the bounty being paid to the grower. The employment of white against black labour is thus protected to the extent of £2 per ton of sugar, or equal to about 4s. 5d. per ton of cane.

The area under cane in 1904-5 was 120,317 acres, an increase of 8801 acres on the previous year, and the largest recorded in the history of the industry, the area being in excess of any previous year. Subjoined are the details production :—

QUEENSLAND SUGAR AND MOLASSES PRODUCTION, 1904-5.

	Sugar. Tons.		Molasses. Gals.
Southern Districts—			
Bundaberg and Gin Gin	30,011	..	785,382
Childers, Maryborough, and Tiaro	17,870	..	438,770
Logan	980	..	36,501
Maroochy and Gympie	2,345	..	112,155
Nerang	480	..	18,000
Marburg	120	..	..
Northern Districts—			
Ayr	10,994	..	176,760
Bowen	3,931	..	140,480
Cairns and Douglas	26,563	..	895,000
Ingham and Mourilyan	26,089	..	908,544
Mackay	28,305	..	979,815
Total	147,688		4,491,407

According to these figures 95,882 tons of sugar and 3,100,599 gallons of molasses were produced in the northern districts, in which coloured labour is principally employed; and 51,806 tons of sugar and 1,390,808 gallons of molasses in the southern districts, where white labour is most abundant. Of the 4,491,407 gallons of molasses obtained in 1904-5, 66,300 gallons went to distilleries; 491,501 gallons were sold chiefly, no doubt, for the production of "golden syrup"; 600,415 gallons were used as food for stock; 201,600 gallons employed as furnace fuel; 29,200 gallons as land manure; 2,304,738 gallons run to waste; and 793,653 gallons kept in stock. Could any means be devised for utilising the surplus molasses, it would further increase the value of the sugar industry. Owing to the drought which prevailed in 1905, it is anticipated that the yield of manufactured sugar for the season 1905-6 will not exceed 150,000 tons.

The progress of cultivation and manufacture has been largely assisted by the Government making provision for the establishment of central mills on the mutual system, a Sugar Works Guarantee Act being passed for that purpose. Advances under this Act have been made to eleven sugar mills, and one tramway, and, under other conditions, to two mills; the total amount advanced up to the commencement of 1905 being £585,286 0s. 6d.; the total amount of indebtedness at the same date being £583,788 6s. 11d., the Government holding security to that amount. The conditions imposed upon each of the eleven companies receiving advances under the Act were that they give the Government a first mortgage over the mill site, buildings, machinery, and plant for the amount advanced. That they pay the amount borrowed, together with 4 per cent. per annum interest, within a period of 21 years from the 1st July, 1900. Such repayments to be in equal half-yearly sums calculated at the rate of £7 2s. 7d. per cent. per annum, and each shareholder being required to give the Government a mortgage over his holding for a proportion of the total sum advanced to the mill, such proportion being determined by valuation by an officer appointed by the Government. These mortgages to be held as collateral security for the amount advanced to the mill—each mortgagor undertaking to repay the amount mentioned in his mortgages, with interest at 4 per cent. per annum, in the event of the mill company failing to meet its debt. The mill buildings, machinery, and plant, to be insured against fire to the extent required by the Government. That the shareholders grow cane in sufficient quantity to keep the works employed to the full extent of their average capacity. Eight mill companies failed in meeting their monetary obligations to the State. The amounts in arrear being: interest, £76,302 11s. 6d.; redemption, £42,714 12s. 8d.; total, £119,017 4s. 5d. The total liabilities incurred by the Goverment in respect of the defaulting companies and the tramway being £415,000 7s. 5d. Six of these mills have now passed into the possession of the Government, and are under the control of the Bureau of Central Sugar Mills. At each of the mills the white labourers are provided, by way of encouragement, with improved lodging accommodation and board as portion of their compensation, the object being to secure the services of good and reliable men; another inducement being a bonus of ten per cent. on the customary rate of wages to all who have gone through the crushing season from beginning to end.

BEET SUGAR.

Although sugar-beet can be easily and cheaply cultivated throughout the Commonwealth, producing with ordinary care heavy crops of the highest character, its utilisation for the purpose of manufacturing sugar has never been practically attempted outside Victoria, where, in 1896, arrangements were made for granting State assistance to sugar-beet cultivation, the result being the formation of a company, which erected at Maffra a factory having a capacity for dealing with 420 tons of beet per day, but want of a sufficient supply of suitable beet led to the works being closed in 1900, after an expenditure of about £100,000 of public money. It is now proposed to secure the assistance of British or German capitalists in developing the industry especially if the abolition of Polynesian labour should be found to adversely affect sugar production in Northern Queensland. The European production of beet sugar in 1905 was estimated at 4,681,000 tons, which shows not only the extent to which it influences prices in the world's markets, but also the possibilities of cultivation in Australia. There is, however, a probability that at no distant date beet may become a staple crop in Victoria. Experiments made with the grass-tree lands of Heytesbury Forest district have shown it to be eminently suitable for beet cultivation, and the Victorian Director of Agriculture affirms that it is the place destined "to grow all the sugar required in Australia." Western Australia is also mentioned as a country in which beet could be grown in considerable quantities.

IMPORTS AND EXPORTS.

The Federal imports of sugar during 1904 showed a diminishing tendency, due largely to requirements being met by local production. The value of the imports during the past three years was—1904, £415,120; 1903, £1,054,338; and in 1902, £1,120,512. The exports of Australian-grown sugar during 1904 was £16,669, against £22,079 in 1903, £11,599 in 1902, and £48,396 in 1901.

The Queensland Government has lately foreclosed its mortgage upon five of the central sugar mills, as the shareholders have failed to pay the interest on the loans.

THE PRODUCTION OF EARLY-MATURING CANES.

By C. A. Barber, M.A., F.L.S., Government Botanist, Madras.

Shortly after starting the Samalkota Sugar Station, a difficulty was experienced in dealing with the packages of canes received from various parts of the country when the local planting season had passed and no land was ready for their reception. Various methods of "hatching" were tried, by which the canes, whole or cut up, were placed in shallow pits and covered up, but these did not satisfactorily overcome the difficulty, and were found to give uncertain results in the soil of the Godavari delta, especially after a long journey. A small nursery was, therefore, rapidly got into order and, following the method adopted in Ganjam, the sets were at once planted thickly as is done in paddy seed-beds. This method was perfectly successful, and the canes suffered in no way on being taken out and transplanted to the lands prepared for them.

About the same time attention was drawn to the Kistna delta, where, with excellent soil and an abundant irrigation from canals, no sugar cane at all is planted. While in the Godavari delta, however, irrigation is carried on for eleven months out of the twelve, the water is only available in the Kistna delta for nine months. If by some means we could reduce the period of growth of the canes to nine months, many thousands of acres would be available for this valuable crop. The way to this appeared to be opened by the nursery experiment above mentioned.

These facts led to the study on the farm of various methods of producing early-maturing canes. Although the work is still in its infancy, and exact analyses have not been accumulated in sufficient quantity to demonstrate every point, enough material has been collected to make it desirable to draw the attention of workers to this line of experiment. It is hoped especially that cane growers living in regions of limited irrigation may take the matter up and make further experiments not possible in rich delta lands.

The nursery method of progagation has been introduced successfully into various parts of the Madras Presidency. By it we were able last year on the Samalkota farm to plant up thirteen times the area of the seed-bed, and, while this cannot be done in all cases, it is evident that the land to be finally planted may be many times as large as the nursery. It is frequently possible to set aside an acre of land under a well close to the village site and plant this at a time when general agricultural operations are out of the question. Such an area would furnish seed cane for quite a large field, and the period of water scarcity could thus be bridged over from one season of irrigation or rainfall to another.

In the latest experiment on the farm, the seed-bed was planted on the 29th March, 1905, and the young canes were transplanted on the

4th of June. The canes were analysed once a fortnight from the beginning of December until the harvest. They were judged to be ripe eight months after the time of transplanting. Compared with similar plots planted with sets from the beginning, the length of time from planting to reaping was the same. The period of growth in the field saved by the experiment was therefore exactly equal to the time spent in the nursery. We cannot say whether this would always be the case, and it is at least doubtful whether the crop would be as good as in ordinary planting,—probably not. Comparative experiments have still to be made on the subject, but there are some indications that the produce of seed-bed canes has a certain resemblance to ratoons or second-year canes.

The importance of this method of planting canes cannot be overrated in places where the period of irrigation is short, or where the exact date of the advent of seasonal rains cannot be foretold. There is no longer any need for keeping the cane standing in the field (standovers) month after month, in the hope of rain coming. The cane sets may be cut at the time of harvest and immediately planted in a nursery, the land intended for the crop may be prepared in a more leisurely manner and the canes transplanted when it is ready and when the danger of a water famine has been averted.*

"Stool-planting" is another method adopted at the Samalkota farm. After the canes are cut, the "roots" (more properly called stools) have to be removed for the preparation of the land for the succeeding crop. If these stools are cut up they may be planted without danger. Supposing the canes were originally planted at the rate of 10,000 to the acre, the stools therefrom may be made to plant up five times the area. For it has been found in trials on the farm that, owing to the invariable and rapid growth of all the divided stools, they may be economically put in at the rate of 5,000 to the acre, and that each stool will provide at least two or three plants.

By this method of stool-planting the period of water scarcity can also be partially bridged. If the canes are cut in the ordinary course, the stumps will remain in the ground for a considerable time without dying and thus a part of the time of short water may be passed. Moreover, the stools mature earlier than plant canes, so that their period in the ground is shorter. The exact advantages of this method of cane-planting have not been fully worked out, and will probably vary a good deal in different parts of the country. One of the greatest is that, with proper care, no filling up of blanks will be needed. A full stand can be obtained at the start, a very important matter in successful cane cultivation. The plots planted in this way resemble ratoons even more than those planted from seed-beds, and the yield is probably less than from plant canes. On the other hand, the old roots are utilised as seed, and the canes are far more healthy than ratoons. The plants are not so long a time in the ground, as stool-planted plots ripen earlier than those planted from sets. This agrees with the well-known character of ratoons which, in the Godavari district, mature one month earlier than plant canes.

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* Some other advantages of a nursery may be noticed. Many, if not all, diseased sets can be eliminated; and a more uniform stand of canes can be obtained.

"Trashing" or stripping the canes of their dead leaves, so frequently done in moist lands in the West Indies, was tried on the farm, and the canes in one experiment ripened a month earlier than in the control plot treated in the ordinary way. The experiment is isolated and therefore not conclusive, but the result is in the direction that would naturally be expected. More experience is necessary before the method can be recommended under Indian conditions. Its usefulness will probably vary in different tracts, and where the canes are liable to be attacked by jackals or where the atmosphere is very hot, it is less likely to be advantageous. To take the case of the Godavari delta, the canes are heavily wrapped round with their own dead and dying leaves to bamboos and to one another. This at first sight appears to be an unreasonable practice. But when one considers the great height to which the canes grow in good crops (some canes last year, when laid out, measured 26½ feet in length over all), and the violent storms which usually occurs towards the ripening time, as well as the frequency with which the canes are attacked by numerous jackals and wild cats, it is difficult at present to suggest any certain improvement. Trashing can only be done with hard-rinded canes of a bunching habit.

The feeding of the cane and its general treatment have a great influence on the time required for ripening. It may be stated generally that, when starved, its growth is limited and ripening is hastened. The manurial plots on the Samalkota farm have been of a comparatively simple nature, being mainly devoted to the comparison of the effect of different quantities of nitrogenous food in the form of oil-cakes. Analyses made at intervals for some months before harvesting have shown very conclusively the effect of such manures on the ripening of the canes in the heavy delta lands. In each and every case the rate of ripening was retarded in proportion to the excess of nitrogen in the manure. When a heavy dressing of oil-cake was supplied the crop was of great bulk, but the canes had not ripened after a full twelve months, whereas in the case of the application of ordinary "village manure," the canes ripened in nine to ten months. The application of manures must then be carefully considered, and nitrogenous manures in the form of oil-cake must not be given in too large quantities when it is desired to shorten the period of the cane's growth.

This latter fact brings us to the conclusion that it is generally useless to expect very large yields with a short period of cane growth, and that efforts at reducing the time in the ground are likely to be accompanied by a diminished yield. It may be stated as a general rule that, within certain limits, the longer the cane is in the ground the larger is the crop. It should be noted, for instance, that the enormous yields quoted from New South Wales are stated to be from canes 18 months old. In the same way some *Mogali* canes, recently distributed from the Samalkota farm to a planter in Mysore, were reported to produce 6⅗ tons of jaggery to the acre at 18 months. This is the converse side of the problem. There are comparatively few places where the canes can be successfully grown for much more than a year, but it may be quite worth while to consider in special cases whether it will not be more economical to lengthen the period of growth instead of restricting it.

In conclusion, there is no doubt that certain canes require a longer period for their growth and maturity than others, although this subject is still rather obscure. The rate of ripening is obviously one of the first factors to be determined when introducing canes to fresh localities. There is great activity just now in bringing canes from the ends of the earth and trying them in various places suitable and the reverse. While some of these efforts will succeed, others will undoubtedly fail, and a record of these successes and failures will be of use in judging which canes are suited to which conditions. This opens a great field for observation, which should not be left to the agricultural departments alone, but in which every cane grower should take part.—(*Agricultural Journal of India.*)

CONSULAR REPORTS.

Porto Rico.

The most notable fact of the year is the great advance made in the sugar industry, which, thanks to the free market of the United States, is attracting capital. The moderate boom of last year is being rapidly improved upon and undoubtedly will continue until every acre fit for cane cultivation is so occupied. Two new centrals came into work during the year; five more will be ready for the next crop, while various *bonâ fide* projects are in hand for other factories.

To feed all these schemes every acre suitable in the vicinity of the localities chosen is already engaged, and arrangements are rapidly being completed to make the more distant places available for cane supply by connecting them with the factories by means of light railways or branches of the existing railroad system.

Good sugar land now is worth anything from £20 per acre, from which a planter can expect a return from £15 to £20 per acre, but the sugar manufacture itself can only be profitably undertaken by capitalists.

The average sugar production of the island is about 2 tons to the acre, which yield is capable of much improvement through the use of fertilizer and practice of modern methods of cultivation and extraction.

The crop of the year exported, including molasses, was valued at £2,760,417, an advance on last year of £743,161.

Ponce.—Mr. Vice-Consul Toro reports as follows:—

The year 1905 was a prosperous one for this district, principally due to a very high sugar market and a large sugar crop.

The average price of sugar was about 18s. per 100 lb. centrifugals of 96° test. Total exports were 309,769 bags centrifugal sugar and 993 hogsheads muscovado sugar, equal to about 42,688 tons, against 33,738 tons in 1904; to this increase of 8,950 tons must be added about 5,000 tons, which were sold for local and island consumption, thus giving a total increase of 13,950 tons. Total value of sugar exported was £790,380 against £469,195 in 1904.

As a consequence of the high price of sugar, lands suitable for cane growing rose in value, and some sales were made as high as £50 per acre; and, furthermore, some land was leased for cane growing under five and ten years' contract at £3 to £5 an acre per annum.

Two new central factories were organised; one of about 4,000 tons, by name "Central Florida," will take off its first crop next year, and the other one of about 8,000 tons sugar, is under construction and will be ready in 1906.

Both central factories were financed exclusively with local capital between owners of the land and some Ponce merchants.

The large central factories of this district have not published any official reports, but it is said that Guanica Centrale made 25,830 tons of sugar and Centrale Aguirre made 22,300 tons.

The French company, "Compagnie des Sucreries de Porto Rico," made its first crop, and gave a dividend of about 4½ per cent. on a capital of £180,000.

No clear or definite statement can be obtained about the new system of diffusion of bagasse; an increased extraction seems to have been obtained from canes, but the extra expenses for fuel are reported as extremely high.

Prospects for the 1906 crop in this district are very good, and a large increase in exports is anticipated.

Molasses continue to decrease in this district, as little muscovado sugars are now made. The exports were: 1905, £31,501; 1904, £50,783. The output in gallons, including centrifugal molasses, was 1,196,489 gallons in 1905 against 1,432,587 gallons in 1904.

Centrifugal molasses for distilling purposes were sold at 1½d. per gallon for export, and large quantities were also used for local distilleries, which produced about 300,000 gallons of rum.

Mayaguez.—Mr. Vice-Consul Steffens reports as follows:—

The sugar exported from Mayaguez during the years 1902–05—exclusively to the United States—was

Year.	Quantity. Tons.	Value. £
1905	4,820*	79,325*
1904	4,310	72,375
1903	7,160	96,505
1902	10,190	122,385

Prices opened at about 4¾ c. first cost for 96° centrifugals, advancing by degrees to 5⅛ to $5\frac{5}{16}$ c. by middle of the crop, when a gradual decline set in, reaching 4 c. and even 3¾ c. at the close of the campaign.

Owing to the high range of prices, as stated above, the plantings of cane have been very important, in consequence of which there is now considerably more cane to be ground than the existing factories can possibly attend to, although all of them have increased their machinery, some even doubling their capacity.

The exports of molasses were:—

Year.	Quantity. Gallons.	Value. £
1905	595,213*	19,315†
1904	480,556	18,100
1903	640,016	24,545
1902	695,206	23,110

To British North America about 407,519 gallons were shipped, value £14,450.

Prices ranged from 8 to 18 c. per 110 gallons first cost, according to grade.

EQUADOR.

The production of sugar throughout the Guayaquil district, which is encouraged by an import duty on foreign sugar of about 7s. 6d. per 100 lbs. has been continued during the past five years; the sale price in Ecuador being kept up by the above-mentioned import duty. The actual sale price is, and has been for some considerable number of years, 10 sucre (£1) per 100 lbs. of fine white sugar, equals 2½d. per lb. In 1904, by a miscalculation of the syndicate, an exceptionally large exportation of sugar occurred, so much so that for the months of May to August the whole Republic was short, indeed almost bare of sugar, and though the syndicate did not raise the price above the 10 sucre per 100 lbs., the actual consumers were bled by the middlemen, many of whom made as much as 25 to 30 sucre (£2 10s. to £3) out of the sack they bought for 10 sucre, or £1. In consequence of this a serious attempt was made to get the import duty on sugar reduced to 2 c. per kilo. (or 3s. 9d. in all per 100 lbs.), so as to allow the Peruvian sugar to compete with the native product and keep the price down below £1 per 100 lbs., but this project did not pass Congress.

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* About. † About.

The sugar producers, since 1902, have been making a great effort to introduce the Guayaquil sugar to the markets of the interior, but owing to the excessive cost of conveyance, were unable to do so until the opening of the railroad to Riobamba gave them increased facilities. They have taken so considerable an advantage of this that the previous importation of Columbian sugar to Quito and some of the other Andean markets has been practically stopped. The consumption of Ecuadorean sugar has been increased over 50 per cent. and the poor crop of 1905 (127,000 quintals*) was wholly consumed in the country, and the syndicate still find themselves short, and will have to import from 800 to 1,000 tons. Considering that in previous years only about 60,000 to 80,000 quintals could be sold in Ecuador, and the excess had to be exported at a considerable loss, this has been a great advantage to the sugar producers, and as they can easily increase their production, the outlook for this industry in future years is distinctly encouraging.

ITALY.

The Italian sugar industry has grown very materially in the last ten years, and now consists of 33 mills and five refineries, and gives employment to some 12,000 hands during the season, which lasts about three months, and permanent employment besides to 5,000 men as workmen, clerks, and general employés. The wages and salaries paid amount to nearly 5,000,000 lire (£200,000). The mills and refineries belong to 18 different companies with a paid-up capital of 108,200,000 lire (£4,328,000), and a turnover of more than 500,000,000 lire (£20,000,000). In the year 1904-5, they paid in duty on sugar alone 73,000,000 lire (£2,920,000), besides the ordinary taxes on land and buildings, and may be calculated to amount in their case to another 2,000,000 lire (£80,000). The ground covered by the roots amounts to about 40,000 hectares, or 100,000 acres, and employs some 12,000 labourers, yielding from 500 to 800 lire per hectare, or, roughly, £8 to £13 an acre, besides the by-products for feeding cattle and producing manure.

The consumption of sugar in Italy is calculated to amount to 6½ lbs. per head of population per annum, much less than the consumption among northern nations, and the fiscal laws of Italy stand in the way of utilising the roots to the best advantage, as molasses and alcohol, which might be obtained from them as well as sugar, cannot in existing circumstances be produced at a profit.

Much interest has been aroused by the rumour that the West Indian planters intend to erect a sugar refinery in Canada to deal with their sugar, and thereby to dispense with the monopoly of the Canadian refiners.

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* 1 quintal = 1·96 cwts.

MONTHLY LIST OF PATENTS.

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ENGLISH.—ABRIDGEMENTS.

14662. J. E. M. VINCENT, Edgehill (Warwickshire), near Banbury, Oxon, and K. GENGNAGEL, Ph.D., Eastbourne, Sussex. (A part communication from R. J. L. Witty, of Yatala, Queensland, Australia.) *Improvements in the production of saccharine cattle food from molasses and sugar syrups, mainly with respect to the materials employed therein.* 17th July, 1905. This invention relates to the employment of the maize plant, harvested as hay before the maturing of the corn, ground and combined with molasses or sugar syrups for the production of saccharine food for animals.

16269. D. STEWART & COMPANY (1902) Limited, Glasgow, and T. WISHART, of the said firm. *Improvements in evaporators for sugar.* 10th August, 1905. This invention relates to evaporators for sugar liquor, and it has for its object to provide in conjunction with such apparatus an entrainment preventer of improved construction, designed to more effectually prevent loss through particles of liquor being carried away with the escaping vapour from the concentration process.

17554. C. H. BERTELS, of Brussels, Belgium. *Improvements in or connected with processes for the purification of sugar juices.* 30th August, 1905. This invention relates to a process for the purification of sugar juices by means of hydrofluosilicic acid, according to which the sugar juice at about 22° Beaumé is cooled, and the acid solution at about 32° Beaumé is added in the requisite quantity whilst the liquid is stirred, and after the precipitate has formed and settled the clear liquid is decanted, whereby a liquid is obtained which is easy to filter, the neutralization of the liquid is made possible, and the recovery of the hydrofluosilic acid is made easy.

22435. R. KÖNIG, of Brussels, Belgium. *Improvements in or relating to mechanical blueing apparatus for use in the treatment of sugar.* 2nd November, 1905. This invention relates to a mechanical blueing apparatus, characterized by a closed vessel combined with a cock, enabling the blueing liquid in the said tank to be measured exactly in an automatic manner, as well as admitting steam before and after the blueing.

8291. H. W. AITKEN and W. MACKIE, both of Glasgow, North Britain. *Improvements in and connected with sugar cane mills.* 6th April, 1906. This invention relates to a preparatory-roll housing of the type in which the bushes for both the rolls are carried in one gap by long bolts, or bolts and springs, a part on the lower end of the housing so shaped that it rests directly on a stool, the part and the stool being formed in such manner that the lower ends of the usual bolts are accessible, whilst, at the same time, the position of the stool is such that the preparatory rolls are carried comparatively close to the main rolls and yet allow the inner lower main roll to be removed without disturbing the stool; and a bracket securing the upper part of the housing to the headstock of the mill.

10278. C. SCHULER, Grevenbroich (Rhineland), Germany. *Improvements in or relating to centrifugal machines for clarifying and washing sugar and similar materials.* 2nd May, 1906. This invention relates to a centrifugal apparatus for clarifying and washing sugar and similar material, in which chambers are connected in a tight but detachable manner to moulds arranged on the centrifugal drum and containing the material, the clarifying or washing substance being supplied to the said chambers, characterized by the lower portions of the chambers being narrowed relatively to the upper.

GERMAN.—ABRIDGMENTS.

170307. HERMANN STECKHAN, of Breslau. *A process for the continuous diffusion of beetroot shreddings or bagasse.* 5th November, 1903. This diffusion process is characterized by the juice which is discharged under pressure from a given diffuser (for instance 8) being divided into two parts, of which one is drawn off to the measuring vessels of the saturation, whilst the other is simultaneously used for mashing a fresh diffuser (for instance 9) charged with shreddings.

170895. A. WERNICKE MASCHINENBAU-ACTIEN-GESELLSCHAFT, of Halle-on-Saale. *A centrifugal drum with double straining casing.* July 26th, 1904. In this arrangement the inner straining casing, which is composed of several similar parts, is directly connected with the usual annular segment shaped insertions and may be withdrawn simultaneously with them, whilst after having been lifted out the sieves or straining pieces and the annular insertions may be separated by drawing the straining pieces away in a radial direction from the annular insertions.

In another form of construction of such a centrifugal drum, guide bars are arranged on the outer face of the inner sieve or straining casing, which bars are in contact with guide bars on the inner face of the fixed external straining casing, with the object of facilitating the lifting out of the annular insertions connected with the inner straining parts.

171035. ISABELLA SCHETKE-RASSAY, née HOFLECHNER, of Vienna. *A process for purifying sugar solutions by systematically precipitating the non-sugar substances by means of known purifying substances.* May 12th, 1904. This process is characterized by the sugar solution having first added to it a sulphate salt (for instance, aluminium sulphate) adapted to convert the existing alkaline salts into alkaline sulphate, the solution is then treated with lime and carbonic acid, filtered and then treated with basic aluminium sulphate, which may also be produced in the solution itself, for the purpose of precipitating the alkalies, and then again filtered, whilst for the further removal of the remainder of the alkalies the filtrate obtained may have added to it a natural magnesium or aluminium-silicate or even a mixed silicate with a simultaneous addition of strontia or baryta, the solution again filtered, then treated with ammonia or amine bases, saturated with sulphurous acid until the last traces of lime are removed, filtered and finally converted by boiling into a masse-cuite or large grain, whilst the chlorides which are converted by means of ammonia or the amine bases into sulphate of ammonia and sulphate of amine are respectively decomposed or expelled.

172068. JULIUS SCHULTE, of Hagan, Westphalia. *A beetroot shredding machine having wedge-shaped pressing channels symmetrically arranged on the cover disc.* February 5th, 1903. In this beetroot shredding machine one or more pressing channels are symmetrically arranged on the cover disc for the purpose of a uniform loading of the shreddings disc. In another form of construction of the machine only one pressure channel is bordered at the discharge end by a rigid catch plate, the other channel or channels by flexible or elastic plates, with the object of enabling any foreign matters which may come into the machine to be rapidly detected.

NOTE.—Copies of all published specifications with their drawings in these lists can be obtained from W. P. Thompson & Co., 6, Lord Street, Liverpool, at One Shilling a copy for English or American Patents, and Two Shillings for German. In ordering please give number and date.

Patentees of Inventions connected with the production, manufacture and refining of sugar will find *The International Sugar Journal* the best medium for their advertisements.

The International Sugar Journal has a wide circulation among planters and manufacturers in all sugar-producing countries, as well as among refiners, merchants, commission agents, and brokers, interested in the trade, at home and abroad.

The Dutch Government have fixed the following import duties on dessicated milk containing sugar. When the proportion of sugar does not exceed 10, 20, or 50 per cent., the respective duties are 2·70, 5·50, and 13·50 fl. per 100 kg. (1 fl. = 1s. 8d.); when it exceeds 50 per cent., the duty will be 25 fl.

IMPORTS AND EXPORTS OF SUGAR (UNITED KINGDOM)

To end of July, 1905 and 1906.

IMPORTS.

Raw Sugars.	Quantities.		Values.	
	1905. Cwts.	1906. Cwts.	1905. £	1906. £
Germany	2,594,230	5,584,350	1,615,085	2,379,114
Holland	82,119	47,779	58,426	17,981
Belgium	281,918	288,065	209,686	116,278
France	118,999	162,359	88,098	69,187
Austria-Hungary	320,074	153,272	217,917	62,500
Java	1,513,756	158,997	1,097,360	73,466
Philippine Islands	....	....	....	....
Cuba	....	111,910	....	41,943
Peru	744,133	426,255	530,434	192,997
Brazil	36,864	955,005	23,887	373,554
Argentine Republic	....	....	....	....
Mauritius	138,417	127,205	78,350	48,362
British East Indies	245,133	77,862	136,198	30,543
Straits Settlements	134,061	48,856	71,261	20,394
Br. W. Indies, Guiana, &c.	833,286	1,348,933	683,931	720,251
Other Countries	637,586	168,037	446,368	77,669
Total Raw Sugars	7,680,576	9,658,885	5,257,001	4,224,239
Refined Sugars.				
Germany	5,967,382	7,299,135	4,896,992	4,143,688
Holland	830,675	1,681,088	717,578	1,005,479
Belgium	150,279	221,772	128,609	128,100
France	759,417	1,316,900	629,288	731,585
Other Countries	312,449	436	256,858	323
Total Refined Sugars	8,020,202	10,519,331	6,629,325	6,009,175
Molasses	1,403,202	1,608,993	281,722	305,754
Total Imports	17,103,980	21,787,209	12,168,048	10,539,168

EXPORTS.

British Refined Sugars.	Cwts.	Cwts.	£	£
Sweden	184	127	168	114
Norway	11,388	9,870	9,066	5,933
Denmark	45,528	63,824	34,407	32,107
Holland	42,759	44,827	34,547	26,600
Belgium	3,663	5,821	2,662	3,268
Portugal, Azores, &c.	9,175	18,260	7,015	9,871
Italy	1,972	22,345	1,394	11,419
Other Countries	142,537	373,325	132,789	239,935
	257,206	538,399	222,048	329,247
Foreign & Colonial Sugars				
Refined and Candy	12,565	27,224	11,769	16,585
Unrefined	43,707	136,457	32,756	69,923
Molasses	2,640	5,464	793	1,742
Total Exports	316,118	707,544	267,366	417,497

UNITED STATES.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1906. Tons.	1905. Tons.
Total Receipts Jan. 1st to August 23rd	1,368,354	1,232,740
Receipts of Refined ,, ,,	1,510	748
Deliveries ,, ,,	1,400,386	1,157,128
Consumption (4 Ports, Exports deducted) since January 1st	1,271,400	1,110,555
Importers' Stocks, August 22nd	26,501	75,612
Total Stocks, August 29th	271,000	185,670
Stocks in Cuba, ,,	77,000	210,000
	1905.	1904.
Total Consumption for twelve months	2,632,216	2,767,162

CUBA.

Statement of Exports and Stocks of Sugar, 1905 and 1906.

(Tons of 2,240lbs.)	1905. Tons.	1906. Tons.
Exports	789,213	983,101
Stocks	290,438	142,881
	1,079,651	1,125,982
Local Consumption (seven months)	25,260	25,950
	1,104,911	1,151,932
Stock on 1st January (old crop)	—	19,450
Receipts at Ports up to July 31st	1,104,911	1,132,482

Havana, July 31st, 1906. J. Guma.—F. Mejer.

UNITED KINGDOM.

Statement of Imports, Exports, and Consumption for Seven Months ending July 31st.

Sugar.	Imports. 1904. Tons.	Imports. 1905. Tons.	Imports. 1906. Tons.	Exports (Foreign). 1904. Tons.	Exports (Foreign). 1905. Tons.	Exports (Foreign). 1906. Tons.
Refined	721,095	401,010	525,966	827	628	1,361
Raw	419,314	384,029	482,944	3,005	2,185	6,822
Molasses	52,313	70,160	80,499	79	132	273
Total	1,192,722	855,199	1,089,409	3,911	2,945	8,456

	Home Consumption. 1904. Tons.	Home Consumption. 1905. Tons.	Home Consumption. 1906. Tons.
Refined	533,434	401,596	504,642
Refined (in Bond) in the United Kingdom	295,942	304,954	327,450
Raw	75,246	59,060	73,343
Molasses	48,906	65,311	73,775
Molasses, manufactured (in Bond) in U.K.	35,272	30,422	34,330
Total	988,800	861,343	1,013,540
Less Exports of British Refined	16,779	12,860	26,920
Total Home Consumption of Sugar	972,021	848,483	986,620

STOCKS OF SUGAR IN EUROPE AT UNEVEN DATES, AUG. 1ST TO 25TH, COMPARED WITH PREVIOUS YEARS.

IN THOUSANDS OF TONS, TO THE NEAREST THOUSAND.

Great Britain.	Germany including Hamburg.	France.	Austria.	Holland and Belgium.	TOTAL 1906.
163	549	487	278	130	1606

	1905.		1904.		1903.		1902.
Totals	1107	..	1478	..	1749	..	1797

TWELVE MONTHS' CONSUMPTION OF SUGAR IN EUROPE FOR THREE YEARS, ENDING JULY 31ST, IN THOUSANDS OF TONS.

(Licht's Circular.)

Great Britain.	Germany.	France.	Austria-Hungary	Holland, Belgium, &c.	Total 1905-06.	Total 1904-05.	Total 1903-04.
1822	1034	649	520	194	4220	3882	4219

ESTIMATED CROP OF BEETROOT SUGAR ON THE CONTINENT OF EUROPE FOR THE CURRENT CAMPAIGN, COMPARED WITH THE ACTUAL CROP OF THE THREE PREVIOUS CAMPAIGNS.

(From Licht's Monthly Circular.)

	1905-1906. Tons.	1904-1905. Tons.	1903-1904. Tons.	1902-1903. Tons.
Germany	2,425,000 ..	1,598,164 ..	1,927,681 ..	1,762,461
Austria	1,510,000 ..	889,373 ..	1,167,959 ..	1,057,692
France	1,085,000 ..	622,422 ..	804,308 ..	833,210
Russia	1,000,000 ..	953,626 ..	1,206,907 ..	1,256,311
Belgium	330,000 ..	176,466 ..	209,811 ..	224,090
Holland	210,000 ..	136,551 ..	123,551 ..	102,411
Other Countries .	410,000 ..	332,098 ..	441,116 ..	325,082
	6,970,000	4,708,758	5,881,333	5,561,257

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☞ The Editor is not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

NOTES AND COMMENTS.

The Government and the Brussels Convention.

We have reason for believing that the Government have already come to a decision with regard to their attitude to the Brussels Convention, and that when the time comes, viz., eleven months hence, they will denounce it. It is difficult to see where the wisdom of taking such an extreme step lies; the advantages of the Convention have, to say the least, outweighed the disadvantages. But a Government which is so firmly attached to the fetish of free trade must needs make a clean sweep of everything which so much as savours of unholy protection, and the Prime Minister has told the Commons that he has failed to see any good in the Convention. Having regard to this, the above decision, momentous as it is, would be only in keeping with the present Government's record of policy. Yet while we must be prepared to fight even to the bitter end for the great principle of fair trade, there is no need for a feeling of panic. For one thing the Convention has two years yet to run, and much may happen before its expiry to upset the Government's plans. Even if the Convention is denounced, the results will not be immediate, and we have hopes that before very many years are past, its continuation as far as we are concerned will be unnecessary for very different reasons inasmuch as Imperial Reciprocity will have become a fact and its benefits will extend to our sugar colonies.

Cuban Affairs.

A Havana correspondent of the *American Sugar Industry* states that much disappointment has been caused to hundreds of sugar planters in Cuba by the decisions of the Spanish Claims Commission which was appointed to consider the responsibility for damages caused to Cuban plantations during the recent Hispano-American war. Apparently some hundreds of plantation owners, who had had their estates wiped out during the war, were sanguine of obtaining adequate compensation from their new suzerain, the United States; but they have found themselves sadly disillusioned. In a list of 84 cases just settled by the Commission no less than 76 were thrown out, because the owners in despair gave up prosecuting their claims. Four others were adjudged favourably, but the amounts awarded were but a trifle of the sums claimed. Thus the Hormiguero Central Company asked for $768,948 and got $10,000. Brook's Estate of Guantanamo claimed $110,000 and were awarded only $500, though their sugar crops, railway station, warehouses, bridges, horses, and cattle, were either destroyed or carried away by insurgents. The Americans may have very good reasons for keeping a tight hold on the purse but it is certain that these decisions will not improve their prestige among the Cubans. Still less will their decision not to acknowledge the citizenship of four claimants, of whom two at least were born in Louisiana, meet with approval.

But for the present all minor questions are shelved by the new crisis which has lately arisen in this island. A revolution is in progress; certain political parties profess to be so dissatisfied with President Palma and his Government that they have taken to arms, and the greater part of Cuba is raging with civil strife. Intervention on the part of the United States now seems inevitable, and can only lead to annexation. But it is said that the *fons et origo* of these disturbances must be laid to the door of certain capitalists of American nationality, and mostly having offices in New York. These men have long desired the annexation of Cuba, and have been persistently working to gain that consummation. It means for them free trade with the U.S.A., and consequently a monopoly of the Cuban trade. For this purpose they have seemingly done their best to foment a revolution, knowing this would be the surest way to make the Washington Government take the extreme step of annexing the island. Their machinations seem to have been only too successful, and at the time of writing the Americans are preparing to pour troops and guns into Cuba to put down the disturbances. This can only result in the downfall of the Palma Ministry and the proclamation of Cuba as a Territory of the U.S.A. Meanwhile, if matters are not soon settled the sugar crops are bound to suffer more or less severely, chiefly from lack of sufficient labour.

Uniform Methods of Analysis.

Several interesting papers on methods of analysis appear in this number. Mr. David L. Davoll, jr., describes an accurate commercial method for the analysis of sugar beets which he considers overcomes some of the objections to the method of hot water digestion, and enables a larger series of analyses to be undertaken within the limits of a working day. We understand that it is his intention to apply this same method to cane sugar analysis, and it will be of interest to know the result of his experiments. Mr. H. Pellet puts forward a plea, by no means new, for some definite unification of the methods employed for saccharine analysis, and proceeds to give his views regarding the utility and reliability of certain present day procedure. But it must be borne in mind that M. Pellet's conclusions are not those of, say, Messrs. Horne, Wiechmann, and Deerr, and that until the question is settled, once for all, as to whether the lead precipitate does or does not influence the polarization, any attempts at unification seem futile. But there is much to be said for M. Pellet's suggestion that the principals of laboratories and experiment stations, as well as the authors of treatises on sugar, should jointly study the question and endeavour to arrive at a mutually satisfactory solution.

Influence of Marl on Heavy Clay Soils.

In 1903-04 a series of experiments were carried out at Bendal's Estate, Antigua, to demonstrate the influence of marl (carbonate of lime) on heavy clay soils. Two plots were laid out: in one the ordinary proportions were made; in the other an addition of 40 tons per acre of marl was made, this latter containing 58·8% of carbonate of lime. This resulted in an increase in the yield of cane to the extent of 1·7 tons of cane per acre. The Report of the 1904-05 Experiments states that "the experiments with ratoon canes were carried on on the same plots, no additional marl being employed. The marled area has given an increased yield of 0·9 ton of cane per acre, the increase in the two crops, under very adverse conditions as regards weather, being 2·6 tons of cane, worth some 28s. With more favourable seasons better results may be looked for. With the introduction of tramways at Bendal's, the application of marl is taking place on a large scale; a considerable area being treated with some 60 tons per acre. Owing to favourable situation and careful laying of the tramway, the marl can be brought from the quarry to the field by gravity; no power being required for haulage, the empty trucks only requiring to be hauled back. In this way the application is inexpensive, the actual cost being £3 17s. 9d. per acre."

Having regard to the figures of income and expenditure given in the above, it is hard to see where the profit of this extra treatment comes in. All depends on what the "better results" amount to. As, however, some remarkable results are said to have been recorded at a home experiment station, owing to the presence of calcium carbonate in the soil, a continuance of the above experiments in Antigua has presumably been decided on.

The Apathy of British Refiners.

A correspondent points out to us, with reference to the meeting of the International Commission for Uniform Methods of Sugar Analysis, that although the sugar question has of late years occupied so much attention, this is the first occasion on which the British Sugar Refiners have been officially represented at these International conferences, and to this meeting only one British Association and one Refiner sent representatives. This British indifference is in striking contrast to the great interest taken by the Continental nations in the application of science to commerce as shown by the following list of Government Departments and Manufacturers' Associations which were represented at the Bern meeting by officials of the highest standing.

Germany.—The Imperial Treasury; the Imperial Physico-Technical Institute; the Imperial Office of Weights and Measures; the Society of Sugar Manufacturers.

Austria-Hungary.—The Society of Sugar Manufacturers.

Bohemia.—The Society of Sugar Manufacturers.

France.—The Syndicate of Sugar Manufacturers; the Association of Sugar and Distillery Chemists.

Belgium.—The Society of Sugar Manufacturers.

Russia.—The Minister of Finance; the Society of Sugar Manufacturers.

United States.—The American Sugar Refiners.

Java.—The Java Sugar Manufacturers.

Antigua.

Mr. J. Lely, of Antigua, a letter from whom appeared in our pages a few months ago, gives rather a pessimistic view of affairs in Antigua in the course of a communication to the *Louisiana Planter*. He states that the sugar industry out there is experiencing serious troubles, of which the worst are the low sugar prices and the threatened exodus of labourers from the plantations to Colon. More central factories are wanted, as well as better shipping connexions. As it is, the muscovado estates are threatened with extinction; the conservatism of some of the planters cannot save them from a natural death. The labour question is however capable of solution, as the introduction of steam ploughs and agricultural instruments will save many hands. Mr. Lely deems the success of the central factories to be a sure thing.

Industrial Alcohol.

Dr. H. W. Wiley, Head of the Bureau of Chemistry in the U.S.A. Department of Agriculture, has been giving some advice to those who are disposed to go in for alcohol manufacture. He strongly discourages farmers from attempting to manufacture alcohol themselves. Apart from the fact that any such proceeding would necessitate a resident excise officer, whose salary would have to be paid by the manufacturer himself, the production of alcohol requires too wide a knowledge of chemistry and too high a degree of technical skill to be attempted by the ordinary farmer. The only profitable plan is to organize central distilleries to which the surrounding agriculturists could bring their raw material. At present practically all of the alcohol made in the United States is obtained from Indian corn; but molasses should soon figure largely as a raw material.

The Lincolnshire Beet Factory Scheme.

The scheme for starting a central sugar beet factory in Lincolnshire seems to be making progress, and may soon be an accomplished fact. At a very representative meeting lately held to discuss the matter, a committee report was presented which recommended the taking of a certain site offered them, subject to the arrangement of advantageous terms with the local railway companies. This report was unanimously adopted; and we may expect ere long to hear of a contract being placed for the erection of the factory.

The Zululand Central Factory.

Reference was made in our last issue to the fact that Sir J. L. Hulett has secured the concession from the Natal Government for the erection of a central sugar factory in Zululand. We now learn that it will be known as the "Amatikulu" factory, and the contract for providing the whole of the machinery needed has been secured by the Harvey Engineering Co., Limited, of Glasgow. The milling plant is to consist of an extra strong nine-roller mill with crusher in front, all driven by strong steel gearing and one powerful engine, with an overhead crane travelling over the whole plant. The rest of the machinery is to be of the most improved design, and will include an extra large Harvey Evaporator, and a battery of Watson, Laidlaw & Co.'s water-driven centrifugals. This is the third central factory the Harvey Engineering Co. have received orders for from Sir J. L. Hulett, so it may be considered that the previous two have proved entirely satisfactory.

Denatured Sugar for Cattle Foods.

We have lately received from M. Albert Bouchon, sugar manufacturer, Massandres (Eure), France, samples of denatured sugar for use as cattle foods. Three varieties are made, in which the sugar is mixed with bran, dry cossettes, and oil-cake respectively; and they seem very nutritious and palatable animal foods. The ingredients are composed as follows:—

Denatured sugar in bran: sugar, 78%; bran, 20%; salt, 2%.

Denatured sugar in dry cossettes: sugar, 78%; cossettes, 20%; salt, 2%.

Denatured sugar in oil-cake: sugar, 78%; oil-cake, 20%; salt, 2%.

The Sena Factory.

In our August issue we referred to the new Sena Sugar Factory, the machinery for which is being put in hand by a Glasgow firm. It appears however that the centrifugal machinery and the crystallization-in-motion plant are to be supplied by Messrs. Pott, Cassels & Williamson, of Motherwell, Scotland, the well known makers of these specialities.

SUGAR IN OUR INDIAN EMPIRE.

Our sugar statistics have hitherto ignored British India, except as regards the small quantity of jaggery imported into the United Kingdom. The great internal production, amounting to some three million tons, has remained "invisible" because it is outside the sugar commerce of the world. So far it may be well for the present to continue this custom. There is no sense in adding a more or less imaginary round figure of two or three million tons to the world's production on the one side of the account and then deducting the same imaginary figure from the other side as the supposed consumption of British India. But there is another aspect under which our Indian Empire is rapidly coming to the front as an important factor in the world's sugar statistics. She is becoming a large importer not only of the cane sugars of Java and Mauritius but also of the beetroot sugars of Germany and Austria. These importations are beginning to take a serious part in the general world's play of supply and demand and thus definitely to influence market prices.

The Austro-Hungarian Government has fully appreciated this fact, and has therefore instituted an enquiry into the character and effects of the fiscal policy of our Indian Government with regard to sugar. A recent report of the results of this enquiry, the work of Dr. Friedrich Karminski of the Austro-Hungarian Ministry of Commerce, is the subject of two interesting articles in the *Journal des Fabricants de Sucre* of the 12th and 19th September, and calls for careful consideration. Dr. Karminski arrives at the conclusion that the Indian countervailing duties of 1899-1903 had no appreciable effect. We propose to show that this is an entirely erroneous impression—one of those deductions so prevalent in the discussion of economic questions, where hasty conclusions are drawn from superficial facts, in ignorance of the broader facts which underlie them.

The line of argument adopted in the report is to give figures illustrating the production of sugar in India before and after the imposition of the countervailing duties, together with the imports of sugar into India and the prices during the two periods, and to conclude from these figures that the countervailing duties had no effect in preventing the steady decrease in production, the large increase in the imports, and the continued low prices. The price is, of course, the governing factor, and therefore it is easy to show at once that Dr. Karminski has been too hasty in jumping at his conclusion. That the price of Austrian refined sugar imported into India from 1899 to 1903 was raised by the amount of the countervailing duty there can be no question. But it must be recollected that during that period the world's price of sugar was forced down by over-production—the result of the bounties, and especially of the Cartel bounties—to a point more than 3s. per cwt. below the average cost of production. This is the reason why prices of refined sugar in India, in spite of countervailing duties, declined from twelve rupees in 1899 to ten rupees in 1902. The decline does not prove that countervailing duties were of no avail, for we know that if there had been no countervailing duties the decline would have been much heavier and would have dealt a fatal blow to the sugar industry of Mauritius and to the small sugar refining industry in India. If we compare the fluctuation in the price of imported refined sugar in Calcutta or Bombay with the price of jaggery in Cawnpore it is at once manifest that the two markets are entirely distinct and governed evidently by quite different influences. The imports of refined supply the wants of the great towns, while the native production of the country is purely for native consumption, with the exception of the small quantity of raw native sugar which is manipulated by the Indian refiner. If Austrian refined sugar had been allowed to enter India in 1901-2 at the parity of 7s. 6d. f.o.b. Hamburg or Trieste, the Indian refiner's industry, and also that of the Mauritius sugar planter, would have been destroyed. The countervailing duty just managed to avert that catastrophe, but it could not alter the fact that over-production had sent the world's price of sugar far below the cost of production. So long as supply exceeded demand throughout the world the surplus had to find outlets where it could, and therefore hundreds of thousands of tons of Europeon beetroot sugar paid the countervailing duty in order to enter the markets of the United States and British India. The countervailing duty is a purely free trade measure; it does not seek to prohibit importation but merely to establish equality of treatment. It cannot countervail the fact of the world's price being below the cost of production, but it can discourage the practice of disturbing the natural course of trade and industry by the giving of bounties, and in that effort it was successful. No Government will for a moment tolerate the giving of a bounty which has to be disgorged when passing the Custom House of the foreign importer. This would be taxing the people for the benefit of the revenue not of their own but of foreign countries.

Since reading the excellent and lucid *résumé* of Dr. Karminski's report in the columns of the *Journal des Fabricants de Sucre* we have turned to the Financial Statement of the Government of India for 1906-1907, where we find at page 21 some paragraphs (80-90) headed "Countervailing Duties on Sugar," and at once discover whence Dr. Karminski has drawn his inspiration. Mr. Baker, the Indian Finance Minister, gives a most interesting and instructive sketch of the course of the Indian sugar industry during and since the period of the countervailing duties, 1899-1903 and 1904-1906. His conclusions are identical with those of Dr. Karminski, namely that the progressive decline in the acreage under sugar cane has not been arrested nor have the imports of beetroot sugar been seriously affected. We hope that what we have written in reply to Dr. Karminski may find its way to the Indian Finance Minister. As to the reduced acreage, there may be other causes for the decline than the great fall in the world's price of sugar. But if not, surely that is a sufficient explanation. We heartily agree with the Minister's concluding paragraph. The abolition of bounties relieves the sugar world of a great incubus. Producers are now free to produce under natural conditions. Prices will be governed in future solely by the cost of production. The best soil, the most careful husbandry, and the most skilful manufacture will prevail. If British India has the soil and climate, and if enterprising capitalists will add the two other requisites, we may see India producing all the refined sugar that her great towns require and perhaps plenty more for other good markets, together with high-class raw sugar for the refining industry at home and abroad.

GEORGE MARTINEAU.

POSTSCRIPT: A FEW STATISTICS.

According to the Financial Statement of the Government of India for 1906-1907, the approximate acreage under sugar cane in British India in each year from 1890-1891 to 1905-1906 has been as follows:—

Year.	Acres.	Year.	Acres.
1890-1891	2,758,000	1898-1899	2,755,000
1891-1892	3,100,000	1899-1900	2,693,000
1892-1893	2,798,000	1900-1901	2,522,000
1893-1894	2,897,000	1901-1902	2,474,000
1894-1895	2,764,000	1902-1903	2,358,000
1895-1896	2,930,000	1903-1904	2,280,000
1896-1897	2,651,000	1904-1905	2,400,000
1897-1898	2,648,000	1905-1906	2,222,000

The *Indian Trade Journal* (Commercial Intelligence Department of India), whose totals do not agree with the above, gives the acreage in each province for this year and the previous year, compared with the average of the preceding five years:—

	AREA IN ACRES.		
Province.	This Year's Crop.	Previous Year.	Average of preceding Five Years.
Bengal	446,900 ..	449,400 ..	494,200
Eastern Bengal	176,100 ..	183,600 ..	——
United Provinces	1,228,900 ..	1,212,600 ..	1,188,300
Punjab..	172,700 ..	325,500 ..	332,900
North-West Frontier..	25,600 ..	25,900 ..	25,900
Madras..	60,600 ..	47,800 ..	50,900
Total	2,110,800	2,244,800	2,092,200

The average of the preceding ten years was for the United Provinces, 1,215,400 acres, and for Madras, 51,100 acres.

The *Indian Trade Journal* also gives the yield in tons of raw sugar (gùr or jàggery) for each province in 1904-1905, the estimated yield in 1905-1906, and the average of the preceding five years.

	TONS OF RAW SUGAR.		
Province.	Estimated Yield, 1905-06.	Yield, 1904-05.	Average Yield of preceding Five Years.
Bengal..	452,300 ..	444,900 ..	492,300
Eastern Bengal	162,700 ..	189,800 ..	——
United Provinces ..	884,000 ..	1,183,400 ..	957,800
Punjab	89,000 ..	238,300 ..	230,400
North-West Frontier..	22,800 ..	22,600 ..	23,200
Madras	114,500 ..	90,000 ..	95,500
Total	1,725,300	2,169,000	1,799,200

The Financial Statement of the Government of India for 1906-1907 gives the following Table of Imports of Sugar into British India by sea in tons :—

	CANE.			Total.	
Year.	Refined.	Unrefined.	BEET.	Refined.	Unrefined.
1890-1	90,944	9,870	45,781	136,725	9,870
1891-2	89,423	7,206	14,027	103,449	7,207
1892-3	77,510	5,596	14,883	92,393	5,596
1893-4	91,305	4,830	10,258	101,562	4,831
1894-5	100,499	9,708	14,324	114,810	9,721
1895-6	89,738	10,297	36,513	126,249	10,299
1896-7	89,782	8,939	44,349	134,123	8,947
1897-8	100,003	18,660	111,768	211,769	18,662
1898-9	111,931	15,629	76,314	188,245	15,629
1899-1900	103,173	21,243	43,625	149,798	21,243
1900-1	153,110	20,432	90,295	243,405	20,432
1901-2	125,190	28,082	147,394	272,583	28,083
1902-3	177,065	22,560	73,485	250,549	22,561
1903-4	251,822	23,820	41,051	292,873	23,820
1904-5	236,099	23,611	87,131	323,229	23,612
1905-6 9 months	168,171	10,381	49,980	218,151	10,381

The Indian Trade Journal adds to this information by giving the countries of origin of the total imports. The following copy omits insignificant items, and arranges the rest in order of importance :—

Imports, Twelve Months ending March, 1906.

Country of Origin.	Cwts. reduced to Tons.	Country of Origin.	Cwts. reduced to Tons.
Austria Hungary	122,682	South America	1,116
Mauritius	100,748	Straits Settlements	505
Java	100,342	West Indies	399
Germany	31,521	Mexico	154
France	11,222	Holland	101
Egypt	6,639	Other countries	139
Belgium	6,122		
Réunion	1,763	Total	384,840
China	1,387		

This gives us the completed imports for 1905-6, of which only the first nine months were given in the other table. It is the highest importation on record. Of this total we find that 171,648 tons were beetroot sugar. In the previous year, out of a total of 346,841 tons 87,131 tons were beetroot. The great European crop of 1905 is a sufficient explanation.

The list of countries of origin credits the United Kingdom with only 353 cwt., but a subsequent table of "quantity and value of beet and cane sugar imported from foreign countries by sea into British

India in the year 1905-6" credits the United Kingdom with 7,101 tons. It erroneously puts this to the credit of both the beet and the cane list which falsifies the totals. Some of the figures differ widely from those given in the previous table. For instance:—

Country of Origin.	First Table.	Second Table.
Java	100,342	84,269
France	11,222	4,315
China	1,387	6,531
South America	1,116	omitted.
Straits Settlements	505	7,544
West Indies	399	omitted.
Holland	101	44

These are some of the minor troubles that await the statistician. In the present case it is not of much consequence. But the next table in the *Indian Trade Journal*, a very interesting one, is in some respects a real puzzle. It gives the prices of sugar in Calcutta, per maund of 82 lbs., for every month in 1905, and for the first five months of 1906. The figures are as follows*:—

	Beet.			Mauritius.			Java. White.			Native Raw Sugar. Gur.		
1905.	R.	a.	p.	R.	a.	p.	R.	a.	p.	R.	a.	p.
January	9	0	0	9	2	0	8	14	0	4	12	0
February	10	0	0	10	0	0	9	14	0	4	12	0
March	9	12	0	9	15	0	9	13	0	4	12	0
April	9	4	0	9	6	0	9	2	0	5	4	0
May	9	7	0	9	6	0	9	7	0	5	4	0
June	8	10	0	8	10	0	8	8	0	5	4	0
July	8	9	0	8	7	0	8	9	0	5	4	0
August	8	0	0	7	14	0	7	10	0	5	0	0
September	8	0	0	8	0	0	7	15	0	5	8	0
October	7	13	0	7	12	0	7	13	0	5	8	0
November	7	8	0	7	4	0	7	4	0	6	4	0
December	7	3	0	7	2	0	7	2	0	6	4	0
Average	8	9	6	8	9	2	8	7	11	5	5	0
1906.												
January	6	9	0	6	8	0		....		6	4	0
February	6	11	0	6	9	0	6	14	0	6	4	0
March	6	8	0	6	6	0	6	9	0	6	4	0
April	6	6	0		——		6	7	0	6	4	0
May	6	7	6		——		6	9	0		——	

The great value of this table is that it shows how nearly the prices of German or Austrian granulated, white Mauritius and white Java correspond. Their fluctuations also correspond with those of the world's price of sugar. But the prices of native raw sugar have evidently no relation with these. At the top of the market, when white sugar was at 10 rupees per maund, native raw was at 4 rupees 12 annas, delivered in Calcutta. As the price of imported sugars gradually declined to 9, 8, 7, and 6½ rupees, the prices of native sugar rose to 5 R. 4, 5 R. 8, and 6 R. 4 per maund. So that in March and April, 1906, when white sugar was at 6½ rupees, native low brown raw sugar (gur or jaggery) was at 6 rupees, 4 annas, almost the same price. There are no doubt very good reasons for this, but we do not know them, we can only guess. One thing is certain, that native raw sugar is, no doubt owing to cost of carriage among other reasons, and perhaps also to superior quality, much higher in price in Calcutta than it is at Cawnpore. Here are the prices, per cwt., of raw native sugar at Cawnpore compared with the prices of white imported sugar in Calcutta for a series of years, as given in the Financial Statement of the Government of India:—

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* 12 Pies = 1 Anna = 1d.
16 Annas 1 Rupee = 1s. 4d.

Price of refined beet-sugar at Calcutta and of Indian raw sugar at Cawnpore on or about the 1st September of each year. Per cwt.

	Calcutta (German Crystals).			Cawnpore (gur or jaggery).		
	R.	a.	p.	R.	a.	p.
1898	10	8	1	4	15	2
1899	11	13	2	4	15	2
1900	12	6	9	6	12	11
1901	10	10	10	6	0	9
1902	9	11	2	4	11	9
1903	10	11	6	5	11	7
1904	10	8	9	6	6	6
1905	10	14	3	5	14	2

The price of raw native sugar at Calcutta for September, 1905, as given by the *Indian Trade Journal* per maund, would work out nearly 10 rupees per cwt. The difference between that and the figure of 5 R. 14a. 2p. as the price in Cawnpore may perhaps be explained by cost of carriage and superior quality. In any case it is evident that the prices of imported sugar and of the native article are not governed by the same influences. When India becomes a competing country as a seller in the markets of the world this anomaly will disappear.

G. M.

Reports from Austria state that snowstorms have been raging within the past few days. This unseasonable weather is bound to affect the beet crop.

INTERNATIONAL COMMISSION FOR UNIFORM METHODS OF SUGAR ANALYSIS.

The International Commission for Uniform Methods of Sugar Analysis was organised in 1897 at the suggestion of the German export trade. Its principal object was to bring to an end the differences which had too frequently arisen between the continental chemists and their English confrères and in general to unify the methods of analysis of sugars, syrups, molasses, beet, &c. It does not profess to decide commercial questions outside the scope of chemistry, such as the taking of samples, but it may intervene in such matters to the extent of giving advice.

The first meeting of the Commission took place, as above mentioned, in 1897, at Hamburg; the second was at Vienna, in 1898; the third in Paris, in 1900; and the fourth in Berlin, in 1903.

The fifth meeting took place in Bern, in August last, and was presided over by Prof. Herzfeld (as on previous occasions). Germany was represented by Prof. Herzfeld, Dr. Hermann (Hamburg), Dr. von Buchka, Dr. Plato, and Prof. Brodhuhn; Austria by Mr. F. Strohmer and Dr. Nevole; France by Messrs. Saillard, Pellet, Dupont, Vilmorin; Belgium by M. Sachs; Great Britain by Messrs. Watt (Liverpool), Main and Macdonald, the chemists of Messrs. H. Tate & Sons; the United States by Dr. Wiechmann; Java by Mr. H. C. Prinsen Geerligs; and Russia by Prof. Schukow.

The first question which came up for discussion was that of the estimation of invert sugar (glucose) in the sugars of commerce. The continental chemists, and especially those of Germany, carry out this estimation in general by first clarifying the sugar solutions with lead sub-acetate (wherein the excess of lead is precipitated) and then treating them with Fehling's solution. The British chemists also adopted this method some years ago, but have abandoned it since for some unknown reason, all save Mr. Watt, who has retained its use. Dr. Herzfeld thought that this difference of procedure was the principal cause of the errors revealed in the different results, and was particularly the reason why the British chemists found traces of glucose in every specimen of beet sugar. It was suggested that the British chemists should adopt the clarification process. The latter could not see their way to this, but it was hoped that in time an understanding would be reached. A sub-committee was formed to reconsider the question. It was composed of Messrs. Watt, Main, Herzfeld, von Buchka, Strohmer, Nevole, Schukow, Saillard, and Sachs. The committee will also discuss whether it be convenient to alter the composition of Fehling's solution.

Dr. Wiechmann presented a report on the taking of sugar samples.

Mr. Saillard submitted a paper on the "Form of Analysis Certificates." specially recommending the form of certificate which is in use in

Belgium. No decision was come to on these two questions; they will first receive more detailed investigation.

Dr. Herzfeld made some proposals for the adoption of fixed colour standards in the place of the Dutch standards at present in use. He submitted for inspection to the meeting some samples of coloured grains of glass. At the same time he did not advise their employment, as the comparison of the colours could only be made in solution. The meeting unanimously expressed the opinion that the valuation of sugars by means of colour tests should be entirely abandoned, such a system being contrary to all practical and scientific knowledge.

Messrs. Wiechmann and Pellet made some observations on the influence of lead acetate in sugar analysis. The further discussion of this subject was postponed.

Messrs. H. Pellet and F. Sachs then drew attention to certain improved methods of analyzing sugar beets. The meeting decided that the analysis of beets should be no longer made by alcoholic digestion but by aqueous digestion; and Messrs. Pellet, Sachs, and Herles were invited to supply further details of their procedure.

M. F. Dupont presented a communication on the adoption of a 20-gramme normal weight for the polarimeter, but the meeting rejected his proposal without any discussion; practically all the members pronounced in favour of a normal weight of 26 grammes.

M. Strohmer finally submitted a report on the testing of beet seed.

The President then took occasion to criticise certain resolutions put at the Rome Congress of Applied Chemistry, in particular the proposal of M. Villavecchia with regard to the unification of the methods for the fiscal supervision of sugar works.—(After F. Sachs in the *Sucrerie Belge.*)

COMPARATIVE TEST OF WATER-DRIVEN AND BELT-DRIVEN CENTRIFUGALS AT EWA MILL.

The staff of the Ewa Plantation Co., Hawaiian Islands, have recently been undertaking some comparative tests of the efficiency of water-driven and belt-driven centrifugals respectively and have published their results in a recent number of the *Hawaiian Planters' Monthly.* Their report is as follows:—

"The accompanying figures are the results of the comparative test of water-driven and belt-driven centrifugals made at Ewa Mills, August 8th to August 11th, inclusive.

"While making this test, great care was taken to have, as nearly as possible, the same quality of masse-cuite to dry,—in each case No. 3 of low purity, which was rather sticky and dried slowly. When making No. 3 we generally have ten cooler cars of masse-cuite per strike. Half of each strike (five cars), was therefore given to each set of centrifugals. Masse-cuite was sampled, at each third machine, from the mixer gates. A sample of molasses was taken every twenty minutes from the flume directly behind the centrifugals.

"The belt-driven machines proved superior in almost every way. While the belt-driven machines would be running full speed in less than one minute after starting it took the water-driven machines from five to ten minutes to reach full speed.

"Also the belt machines dried more sugar, using less fuel oil in a given time, drying the sugar better, and discharging the molasses of lower purity than the water-driven machines. Furthermore, a much larger quantity of sugar crystals passed through the screens of the water-driven machines; which fact may be readily proved by the fact that the percentage of recovery of raw sugar on weight of masse-cuite was 5·7% greater in the case of the belt-driven machines. This is probably due to the rapid start of the belt-driven machines which cakes the sugar more rapidly to the side of the machines, thereby preventing much small grain from passing through with the molasses.

"This advantage of a rapidly-starting machine is directly contrary to the claim made by one of the makers in favour of a slow-starting machine for drying second sugars:

TABLE A.

40 in. Water-Driven.

Date.	Duration of Test.	Motive Power.	Boiler Pressure per square inch.	Temp. of Feed Water.	No. Oil Burners used.	Gallons Fuel Oil Burned.
Aug. 8.—	10 hrs.	20 in. × 10 in. × 10 in. 3 Duplex Pumps Working as Compound	120 lbs.	178° F.	2	575
Aug. 10.—	8 hrs.	20 in. × 10 in. × 10 in. 3 Duplex Pumps with direct steam	100 lbs.	180° F.	2	637
		30 in. Belt-Driven.				
Aug. 9.—	10 hrs.	Corliss Engine 16 in. × 36 in.	120 lbs.	180° F.	1	343
Aug. 11.—	10 hrs.	Corliss Engine 16 in. × 36 in.	120 lbs.	182° F.	1	361·37

TABLE B.

40 in. Water-Driven.

Date.	No. of Centrifugals.	Water Pressure at Pumps.	R. P. M. of Centrifugals.	Size of Screen.	Lbs. Sugar Dried per Gallon Oil Consumed.
Aug. 8.—	13	180·200	800·900	00	16·5
Aug. 10.—	13	200·210	850·950	00	12·9
		30 in. Belt-Driven.			
Aug. 9.—	32	..	1400	00	47·7
Aug. 11.—	32	..	1400	00	42·6

TABLE C.

Date.	Purity Massecuite.	Purity Molasses.	Lbs. Molasses.	Lbs. Sugar.	Recovery of Raw Sugar.	Polarization of Sugar.
			40 IN. WATER DRIVEN.			
Aug. 8.—	48·4	40	70,308	17,750	20·16	78°
Aug. 10.—	47·2	37·7				77·4°
			30 IN. BELT-DRIVEN.			
Aug. 9.—	47·7	36·6	91,016	31,750	25·86	79·4°
Aug. 11.—	47·7	35·4				78·5°

"In favour of the belt-driven centrifugals the following points will be noted :—

"Lower purity of molasses from approximately identical masse-cuite (2½% to 3½%).

"Larger percentage of recovery (5·7%).

"Increase in polarization (1% to 1½%).

"Large increase in pounds sugar dried per gallon of oil consumed (approximate 30 lbs. per gallon).

"NOTE.—The same Babcock & Wilcox boiler was used in all four tests, having been fired with other fuel, and having steam up before starting test, so as not to interfere with the measured quantity of fuel oil. Although the two oil burners were unable to keep up steam when the direct acting steam pumps were used, when the pumps were compounded a great saving of fuel resulted.

"The third test had to come to a close at the end of eight hours on account of the oil supply tank being of insufficient capacity to hold enough fuel oil to continue.

"The result of the four tests shows a very extravagant use of power, steam, fuel, as well as inferior qualities as a sugar dryer on the part of the water-driven centrifugal."

We hold no brief for any particular design of centrifugal; but we cannot help thinking that the above isolated instance of the alleged superiority of the older over the newer form of drive is supplied by men predisposed in favour of the belt-drive. At any rate certain important considerations seem to have been ignored or omitted.

It is obvious that belt-driven machines are as perfect today as they have ever been in the forty years they have been before the public, while the water-drive has only been in use less than ten years and the latest specimens are a great improvement over the earlier ones of seven or eight years ago. It would only be fair to know when the Ewa water-driven centrifugals were purchased. They are said to take five to ten minutes to get up full speed. As, however, there are other similar batteries in the Hawaiian Islands, which with 180 lbs. water pressure and 2 nozzles reach full speed (900-1000 revolutions) in 2½ minutes, the natural conclusion to draw is, either that Ewa battery is an early and now inferior design or else is not supplied with the requisite power to enable it to run at its best. As a matter of fact we believe the latest patterns of the water-driven machine can accelerate to full speed in 45 seconds with a load of 700 lbs. It is all a question of designing the machine to conform to the conditions and requirements of the particular service. Then again a comparison between 30 in. centrifugals on one hand and 40 in. on the other is hardly fair and diminishes the comparative value of the tests. Many experts hold that the work done by a centrifugal depends on the revolutions per minute, and not on the peripheral speed. Granting this, then the 40 in. machine ought to have run at 1,400 r.p.m. if it was required to dry its charge as quickly as the smaller centrifugal did.

But taking the test as we find it, it simply shows that the particular belt-driven machine was more economical of fuel than the given water-driven one. It would then be pertinent to enquire whether the respective machines were of contemporary manufacture, or whether some 8 or 10 years separated the dates of their construction. Apart from this, the only outstanding result of these trials would seem to be that a quick-starting centrifugal is superior to a slow-starting machine, whatever be the source of driving power.

Where water power is not cheap and handy, resource must be had to belt-drive to work centrifugal batteries; and it is therefore a matter of congratulation that the manufacturers of the older design have brought their machines to such a pitch of perfection as to satisfy the requirements of a modern factory like that of Ewa. But when we find that there are already some 2,000 water-driven machines in use in up-to-date factories all over the world, and orders continue to come in for them in increasing volume, we cannot but conclude, independent of the *pro* and *con* opinions of interested parties, that there are some very superior features in their design which must more than compensate for other possible drawbacks. Public opinion, as gauged by sales extending over a decade, must needs count for more than any number of expert views put forward by predisposed persons either in favour of the design or opposed to it for commercial reasons.

The continental beet crops will not be up to last year's average as regards weight per acre. In Bohemia, according to Czarnikow, some districts seem to have as much as 15% less roots per hectare.

REPORT ON THE ESTIMATION OF GLUCOSE BY THE VOLUMETRIC METHOD.*

By ALEXANDER WATT, F.I.C., F.C.S.

In the estimation of glucose in beetroot sugar, the differences between the results obtained by Continental and British chemists have, for many years, been a source of trouble to buyers and sellers.

In order to ascertain whether the differences were due to the sampling, one of the Liverpool Refiners in 1882 inaugurated a scheme whereby carefully mixed samples of sugar were sent to various Continental and British chemists for simultaneous analysis. This periodical distribution of test samples is still continued, but by the Sugar Association of London, with very satisfactory results.

Even in these samples the differences in the glucose still occurred. This led the British chemists to meet in Conference to ascertain the cause of these discrepancies.

The first Conference took place in London in 1884, at which it was decided not to clarify the solution of beetroot sugar with basic acetate of lead before the estimation of the glucose.

In 1890, at another London Conference, this decision was confirmed. (Digest of Proceedings at a Conference of Chemists, 26th June, 1890. The Beetroot Sugar Association, London.) But in 1896, the third London Conference, we had the advantage of the presence of our friends, Drs. Herzfeld and Hermann, who succeeded in persuading the meeting to adopt the plan of clarifying the solutions before testing in order to obtain uniformity in the method of working, although many of the chemists present were of opinion that all copper reducing bodies should be returned as glucose. The decision come to in 1896 was adhered to for some years, but the differences in the amount of glucose found still continued. (Digest of Proceedings at a Conference of English and German Chemists, 9th September, 1896. The Beetroot Sugar Association, London.)

In a recent examination of the results of the analysis of the test samples before mentioned, it was found that almost invariably the British chemists recorded a higher amount of glucose than their Continental colleagues, and it is rather an unfortunate coincidence that these results should so exactly agree with the commercial interests that they represent.

In an average of about 100 analyses of the test samples made during the last 10 years, it was found that the amount of glucose recorded by the British chemists was more than three times that of the Continental ones.

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* Read at the International Commission for Uniform Methods of Sugar Analysis at its Session at Bern, August, 1906.

My own testings of clarified and unclarified solutions of beetroot sugar show an average difference of only 6% of the glucose present, so that the great difference of 300% in the case of test samples must be due to some other causes than clarification.

In the ordinary course of analysis of the commercial samples of sugar, the differences in the amount of glucose found, although actually very small, have had an undue importance attached to them on account of the effect of the coefficients used for assessing the injurious action of the glucose.

Thus, a sugar containing ·25% of glucose is multiplied by the coefficient 3, but if ·26% is found, the coefficient is increased to 5, causing the rendement to be reduced by ·75% in the one case, and by 1·3% in the other. A difference of $\frac{1}{100}$% between the two analyses is thus magnified to ·55% in the reduction of the rendement. Similarly, in the case of second running sugars, when the amount of glucose passes ·5% the coefficient is increased from 3 to 5, which may increase the error 100 fold.

When the amount of glucose lies in the neighbourhood of the critical points ·25% and ·5%, if great differences in the rendement are to be prevented, from ten to 20 times greater accuracy is demanded than is required for the estimation of the ash.

The process for the estimation of glucose in use in Great Britain is the volumetric, and an examination of it has shown that, as usually worked, it is liable to many sources of error, and it is to the employment of that process by British chemists while the gravimetric is employed on the Continent that I am inclined to attribute the differences found, and not to the failure to clarify the solutions as generally supposed.

When the amount of glucose in any sample of sugar is under 1% very slight variations in the procedure give rise to large percentage errors. For instance, varying the amount of Fehling used, the strength of the sugar solution, the alkalinity of the solution or the time of boiling, gives in each case a different result. But the most serious error is caused by neglecting the effect of the presence of sucrose, which may give a result which will differ from the truth by 20% to 150%.

Attention to this was first drawn in 1874 by Dr. J. W. Gunning (La Saccharimétrie et l'Impôt sur le Sucre, Amsterdam, 1875) in a report to the Dutch Government on saccharimetry and the sugar duties.

In 1884 Mr. J. W. Biggart (*The Sugar Cane*, 1885, p. 135), also pointed out that for his process the Fehling's solution should be standardized with a mixture of sucrose and invert sugar.

At the first meeting of this International Commission in Hamburg in 1897 the same recommendation was repeated.

Notwithstanding this, I do not know of anyone who regularly uses this method in practice.

In the gravimetric process the effect of the sucrose has been carefully studied, and the tables of correction which have been made are generally used by those employing that method. Until the same is done for the volumetric process we cannot hope to get results which will agree with the gravimetric.

Besides the fundamental error of ignoring the presence of sucrose, the varying conditions before mentioned may cause a difference between two determinations of from 5% to 10% of the glucose present.

It is useless, then, to apply the volumetric process as at present used to estimate the difference between clarified and unclarified solutions, as the error of observation is as great as the difference to be observed.

A large number of experiments were made in order to ascertain how these errors could be avoided, with results that were often puzzling and contradictory.

As you know, the conditions in the two processes are very different. In the volumetric, the volume of the solution is constantly altering according to the time of boiling and the amount of glucose in the sample.

This was found to be a great source of error on account of the difficulty found in determining the end of the reaction. After the first addition of sugar solution and boiling, a filtered portion would show abundance of copper, after a further addition of sugar the amount of copper would be found to be less, but after three or four tests the copper would apparently increase and the end of the reduction was found very difficult to determine. The explanation is that instead of the volume being about equal to the number of ccs. added, it was found to be reduced to about one-half or one-third of the volume expected. This had the effect of keeping the amount of residual copper about constant, and also increased the alkalinity which greatly retarded the precipitation of the cuprous oxide. This was remedied by the addition of water, and eventually by the use of an inverted condenser. The copper then diminished regularly with the addition of sugar solution.

When a refined sugar contains only a trace of glucose, boiling with a small quantity of Fehling's solution (1 cc.) causes a milky precipitate of cuprous hydrate of a pale yellow colour, which usually passes through the filter paper, and often in spite of the addition of hydrate of alumina or kieselguhr it is impossible to get it bright enough for testing with acidified potassium ferrocyanide. Long continued boiling remedies this (but the solution has to be reduced to about half its bulk), probably by dehydrating the cuprous hydrate, and converting it into the heavier cuprous oxide. The difficulty can also be obviated by the addition of sodium hydrate, sodium acetate, sodium chloride or Rochelle salt.

When a larger amount of Fehling (10 cc.) is used this difficulty does not occur, which I attribute to the amount of alkali present, indeed it is the alkali that seems to be the determining factor in the amount of reduction that takes place.

This action of alkali was observed in 1872 by Mr. T. L. Patterson (*The Sugar Cane*, 1872, p. 241), who found that the complete precipitation of copper was prevented by the addition of an excess of caustic soda to the Fehling's solution.

I have found that the action of excess of alkali has a still greater effect on the action of the sucrose on the Fehling's solution.

When a solution of 20 grms. of sucrose in 100 cc. water was gradually added to 1 cc. of Fehling's solution and boiled without allowing the solution to become concentrated, *11 grms.* of sucrose reduced 1 cc. of Fehling solution. When the solution was concentrated to about one-third of the maximum volume, *14 grms.* were required, and when 1·23 grms. of caustic soda were added to the sucrose solution and boiled with scarcely any loss of water, *20·3 grms.* were required.

The action here seems to be one of inversion being greatest in a dilute solution, less in a strong solution, and about half as much in the presence of caustic soda. The influence of the amount of Fehling used, on the result of the test, may also be considered as the effect of dilution and the amount of alkali present,

Mixtures of sucrose and invert sugar were made in the proportions usually found in beetroot sugar, and the amount of invert sugar estimated in the ordinary way, using a solution of 19 grms. of sucrose in 100 cc. (to represent 20 grms. of sugar of 95% pol. and amounts of invert sugar equal to from ·025% to 1%.

The amount of invert sugar found was in every case greater than that taken, and the excess found varied from 150% in the case of the largest amount, to 20% in the case of the smallest.

If these results are considered as tests of the standard of the Fehling solution, we get glucose equivalents for 10 cc. of Fehling from ·0215 grms. to ·0458 grms. instead of the amount for pure invert sugar of ·055 grms.

If then, instead of using the glucose equivalent for pure invert sugar, the equivalent corresponding to the amount of glucose and sucrose were used, the error due to sucrose would be eliminated, as is the case with the gravimetric method. Until these equivalents are determined under fixed conditions, the result of the ordinary process can be corrected by preparing a solution of pure sucrose and invert sugar in the exact proportions found in the sample, which is then used for standardizing the Fehling's solution under the conditions employed for testing the sample.

The glucose found in the sample multiplied by the ccs. of the standardizing solution and divided by the ccs. originally used, will give the glucose free from the sucrose error.

If a clarified solution is used, it is also necessary to clarify the standardizing solution, before titration. When the above mentioned errors are corrected, I believe that the volumetric method is capable of estimating much smaller quantities of glucose than the gravimetric, and with an equal degree of accuracy.

ON UNIFORM METHODS OF ANALYSIS OF CANE FACTORY PRODUCTS.

By H. Pellet.

Whilst it is highly desirable, if not even indispensable, to arrive at uniform methods of analysing saccharine materials in general, we think that this is especially needed in the case of certain products met with in the cane sugar industry. In the beet sucrerie the methods of analysis may be more or less modified without affecting the results obtained, but, as regards the products of the cane factory, many years' experience has shown us that it is almost impossible to arrive at concordant results if the same method of analysis be not always followed.

Admitting that some agreement has been reached, for example, as to the manner of determining the percentage of sugar in megass, it appears to us that chemists engaged in the cane sugar industry ought to come to an understanding as to a general method of analysing the various products of the cane, such as the juice, syrups, masse-cuite, molasses, and sugars. Until this is done most of the analytical data now published must remain open to criticism, for when the same methods of analysis are not adopted the results obtained are no longer comparable, and this frequently gives rise to interminable and useless discussions.

We therefore wish that the unification of the methods of analysis of saccharine products should be studied by factory chemists in Hawaii, Louisiana, Mauritius, &c. We are aware that some steps have already been taken in this direction, but in such instructions we have observed the recommendation of unsuitable methods. At the head of such a movement we would like to see the principals of laboratories and experimental stations connected with the sugar industry; for example, Messrs. Wiley and Prinsen Geerligs, associated with authors of technical treatises, such as Messrs. Deerr and Spencer.

Uniform methods of analysis having once been established, it would then become necessary to make them known, so that they might be adopted in every cane factory laboratory.

The following are our observations and proposals in this direction ;—

1. The results of numerous experiments carried out some time ago, and in different countries, indicate that the use of sub-acetate of lead for clarifying cane products presents the following disadvantages:—

(*a*) The sub-acetate precipitates the reducing matters from solution.

(*b*) These precipitated reducing matters consist mainly of levulose.

(*c*) An excess of the lead reagent modifies the rotatory power of the levulose remaining in solution.

2. This causes :—

(*a*) A decrease in the percentage of reducing matters.

(*b*) A modification of the direct polarization, due partly to the levulose precipitated, and partly to the influence of the excess of lead reagent on the remaining levulose.

3. Experiments have shown that the precipitation of the levulose is not proportional to the quantity of levulose present, and varies with the nature of the other impurities (organic non-sugars, salts, &c.,) and with the ratio of these to the levulose.

4. The reducing matters can only be accurately determined in a solution of the original substance, or in one which has been clarified by a reagent having no action on the reducing matters (levulose).

5. The correct polarization (direct) can also only be determined on a solution treated by a clarifying agent which has no action on the reducing matters and no influence on the rotatory power of levulose.

6. Finally, *the crystallizable sugar in all products of the cane factory should be determined only after inversion by Clerget's method.*

7. The levulose present in cane products being subjected to the influence of heat in the presence of salts, its rotatory power is found to be variable whilst its reducing power, as measured by the copper test, remains unchanged. Hence it follows that in the case of all products of the cane factory it is impossible to calculate the proportions of levulose, and dextrose, and also the modifications or transformations of these two reducing sugars during the manufacture.

8. The percentage of solid matters, as determined by the Brix scale is always in excess of the actual solids. The determination of solid matters should be directly determined by evaporation and drying, using our special capsules and adhering to our instructions.

9. The calculated co-efficients of purity of cane products are all more or less faulty unless calculated from the sugar as determined by Clerget's method, and the solid as determined by actual drying. As a rule they are low and, in the case of molasses, *the difference between the apparent and the true purity may be very great*, as we shall shortly show.

10. Until the unification of the methods of analysis has been effected we request all our colleagues to clearly indicate the method of analysis adopted before publishing any analytical results. To state

for example, whether the solution was clarified with sub-acetate of lead, neutral acetate of lead, sodium aluminate, hypochlorite of lime or of soda, animal charcoal, sulphurous acid, &c., &c. What method is followed for the determination of reducing substance, the crystallizable sugar, and the total solid matters.

The following analysis of cane molasses may serve as an example of the differences observed when one or other method of analysis is employed:—

	First Method. Using sub-acetate of lead for clarification, and Brix = Solids.	Second Method. Using neutral acetate of lead and chloride of lime. Brix = Solids.	Third Method. Using Clerget's inversion method Solids determined by actual drying.
Brix	81·54	81·54	73·28
Water	18·46	18·46	26·72
Polarization	32·40	30·00	36·40
Total reducing matters	14·50	15·98	15·98
Ash (sulphated)	9·97	9·97	9·97
Organic non-sugars	24·67	25·59	10·93
	100·00	100·00	100·00
Apparent purity	39·7	36·8	49·6
Organic non-sugars % on Polarization	76·1	85·3	27·4
Organic non-sugars % on Ash	247	256	109
Reducing matters % on Polarization	44·7	53·2	43·9

Similarly, from the crystallizable sugar as determined by Clerget's inversion and the apparent solids as indicated by Brix, an intermediate purity of 44·6 would be obtained. The great difference in the percentage of organic non-sugars as indicated in the table is due to the fact that these are indirectly determined by difference.

Under these conditions the usual method of analysis (No. 1) is of very little value for the control of a cane sugar factory, and in any case the results obtained in one factory are not comparable with those obtained in another factory if the canes differ in saccharine richness or in any special constituent.

Finally, according to the methods of treating the juice adopted in different factories (*i.e.*, simple defecation, carbonatation, electrolysis, &c.), the composition of the after-products varies so much as regards ash, total reducing matters, and the composition of the reducing matters, &c., that the apparent composition as determined by the usual methods of analysis ceases to have any significance.

On the other hand, when the analyses are made by method No. 3 (in the table), the results obtained express the actual composition of the material analysed, enabling one to trace the modifications or transformations to which the material is subjected during the manufacturing operations, and to draw interesting and practical conclusions such as could never be drawn from the data now generally obtained.

Although the methods of analysis which we recommend for ascertaining the actual composition of the products of the cane sugar factory have been already described in various publications, we hope that a resumé of same may be of interest to those chemists who are not yet acquainted with them and who might be willing to try them, and then compare the results with those obtained by the methods of analysis they are now using.

ANALYSIS OF MOLASSES.

1. Determination of the total solids.

Weigh 3 grams of molasses into one of Pellet's special metal capsules containing about 10 grams of pumice stone, and note the total weight. Dilute the molasses with a little boiling water, add one drop of ammonia, and mix. Dry at 102°-105°C. to constant weight, which will be complete in from 2½ to 3½ hours if the drying-oven be previously heated to the required temperature.

Sand may be employed in place of pumice stone, and the ordinary metal or porcelain capsules may also be used if a sufficient area of the material can be exposed. The addition of one drop of ammonia prevents any slight decomposition during dessication should the molasses be acid. Very concordant results are obtained after a few trial tests.

2. Direct polarization.

A solution is prepared containing six times the normal weight (16·19 grams) in 300 cc. or three times the normal weight (26·048 grams). To 50 cc. of either of these solutions are added a few cc. of a freshly prepared and concentrated solution of chloride of lime, or of hypochlorite of soda, until the colour of the solution is distinctly yellow. Then add two or three cc. of neutral acetate of lead and dilute to 100 cc. Any bubbles on the surface of the solution are first removed by allowing a few drops of strong alcohol to flow down the neck of the flask. The volume is then brought up to the 100 cc. mark, and the liquid mixed and filtered. The clear filtrate is polarized in a 200 mm. tube, the reading giving the direct polarization in the case of the 16·19 normal weight solution, and being doubled in the other case. The crystallizable sugar is determined in another portion of the filtered solution by Clerget's inversion method, with the usual precaution, the temperature of the solution being the same before and after inversion.

3. Determination of the reducing substances.

This is carried out on a portion of the original solution (containing three or six times the normal weight in 300 cc.). To 50 cc. of copper liquor there are added 5, 10, or 20 cc. of this solution, or as much as will contain from 0·10 to 0·15 of reducing matters. The volume of the mixture is made up to 100 cc. and the flask immersed in boiling water until the contents are heated to 87-88°C., this temperature being maintained for two or three minutes. Add 50 cc. of cold water, filter, wash the precipitate with hot water, ignite in a muffle, and calculate the percentage of total reducing matters from the weight of cupric oxide obtained.

(NOTE.—For further details see *The International Sugar Journal* for August, 1906, p. 414.)

4. Determination of the ash.

The usual method for "sulphated" ash is to be adopted.

Once in possession of results so obtained, chemists have only to compare the same with those indicating apparent composition to be convinced of the small value of the latter.

The errors that appear in the analysis of molasses by the usual method exist, though in a less pronounced form, in the analyses of all intermediate products of the cane sugar factory, and in order to arrive at accurate results the same method of analysis must be adopted as has been described for molasses.

A natural objection to our proposal is that the methods are too long for the practical control work of a sugar factory. This must be admitted, but it remains to be shown what has been done in factories where we have established chemical control for over twelve years.

A summary of the chemical control is drawn up at regular intervals, which may be weekly or at intervals of eight or of ten days, when stock is taken of the material in hand. For controlling the work day by day the most rapid methods of analysis can be employed; for example, the direct polarization after clarification with sub-acetate of lead, and the determination of reducing substances by decolouration of the copper liquor. This is quite sufficient provided that the volume of subacetate used for clarifying each product of the factory be determined once every week, so that the results obtained may be strictly comparative.

This being done, a sample of each product of the factory is analysed by the more exact method (No. 3); that is to say, a sample of the juice, syrup, masse-cuite, molasses, sugars, &c. The true composition of each product being thus ascertained, a suitable correction is applied to the average of the daily results obtained by the more rapid methods of analysis, whereby the latter are rendered much more reliable.

Proceeding on these lines it becomes possible to explain why a well crystallized masse-cuite, having an apparent purity of 60·0 appears to give a higher yield of sugar than another masse-cuite of equal, or even higher purity. It is because the *actual purity* of the first product was between 66 and 67, and that of the latter between 63 and 64. The more exact method of analysis also gives us more information regarding the composition of the impurities present; in a word, it informs us as to the comparative qualities of the products analysed.

We hope soon to have the satisfaction of seeing our proposals adopted, namely, the unification of the methods of analysis of the principal products of the cane sugar factory. Useless discussion between colleagues working by different methods will then be avoided.

When our colleagues have become familiar with the use of hypochlorites for clarifying sugar solutions (as prepared by Zamaron) they will find them equally applicable in variable proportions to all the products of the factory, and thus be able to dispense with all other clarifying agents, with the exception of the neutral acetate of lead.

Although we are obviously in favour of uniform methods of analysis, we are in no sense opposed to modifications so long as there are real improvements. If to-day we suggest a certain method it is because the same has proved trustworthy in several large factories adopting different methods of treating the juice. Moreover, the same method of control has also been successfully applied in the refinery and distillery working with cane products. If, on the other hand, certain of our colleagues should see reasons for modifying our proposed method, we are ready to adopt such modifications after trial. In a word, we believe that at present our method of control is the only one capable of yielding reliable and strictly comparative results in raw sugar factories, refineries, and distilleries, in which cane products are treated, and of yielding identical results when the same product is analyzed in different laboratories, which is far from being the case at present.

By way of concluding these observations, we would request the principal chemists engaged in the cane sugar industry to repeat the experiments we have made for proving that *the lead precipitate has no influence on the polarization*, neither in the case of molasses nor of sugars, and consequently that the correction applied by Messrs. Horne, Deerr, Wiechmann, and many others, is quite unnecessary. The true polarization, or, more correctly, the crystallizable sugar, can only be determined in cane products by Clerget's inversion method, and this holds good for raw sugars as well as for molasses. The direct polarization, after clarification with hypochlorite and neutral acetate of lead, is always lower than the true polarization or actual sugar content.

AN ACCURATE COMMERCIAL METHOD FOR THE ANALYSIS OF SUGAR BEETS.

By David L. Davoll, Jun.

(Read before the Sixth Congress of Applied Chemistry, Rome, Italy, April, 1906.)

The indirect analysis of the sugar beet by the juice method and the use of the transposing factor, so much in vogue in the United States, is open to serious objections, for while it does not affect the price paid by the factory, provided a reasonable control is kept over the factor by frequent direct analysis, it is bound to work injustice to individual farmers, while at the same time unduly favouring others.

It has been our experience that the factor progressively diminishes as the harvesting and the beet-storing season advances, varying from 0·95 in early September to 0·88 in late January.

Frozen beets offer serious obstacles to the indirect method, and this condition may occur in most Northern States any time after November 1st.

A factory slicing one thousand to twelve hundred tons of beets per day must be in a position to make in its receiving laboratory from four to five hundred analyses per day of ten working hours, and with the minimum working force. In good weather five hundred ton houses must handle this number.

The practical workings of the much recommended instantaneous aqueous method have not been such as to secure its adoption, and about one hundred and twenty-five samples a day is the limit to the number that may be analyzed with any degree of accuracy by one chemist and assistant in one day, using the ordinary method of hot water digestion in a flask. The latter method is outlined as follows:—

"Ten cc. to sixteen cc. of solution of lead sub-acetate of 54·3 Brix are placed in a 201·2 cc. sugar flask, and 52·096 grammes of shredded beet are introduced by means of a glass rod, assisted by a spray of water; the volume is finally completed to about 190 cc. A little ether is added to beat down the foam, and the whole heated in a water bath at 80° C. for thirty minutes, rotating the flask from time to time to promote extraction and facilitate the escape of air bubbles. Water is occasionally added so that the volume is completed to the mark at the end of thirty minutes. Cool to room temperature, add ether to dissipate any remaining foam, dilute with water to the mark, mix thoroughly, and filter."

The criticisms of this method are the following:—The introduction of the beet pulp into the flask is painstaking and time consuming, a medium fineness of a shredded nature giving most trouble. The rotation to secure proper extraction and get rid of occluded air, when properly attended to, requires much attention and the repeated addition of ether, while careless operators, in practice, neglect rotation, particularly when in a hurry. Where 26·048 grammes are used in 200·6 cc. dilution, the manipulation is more satisfactory, but the use of 200 mm. tubes requires the objectionable doubling of the reading. A double normal should always be taken in commercial work, being more representative of the original sample, since perfectly intimate mixing cannot be counted upon where the chemist is dependent upon the unscientific helper to prepare the sample. Rapid and uniform cooling cannot be obtained without stirring the flask contents, which is difficult. After adding the final quantity of water, intimate mixing of the water contents, which is absolutely essential, is rendered difficult by the presence of the pulp.

The author has overcome the objections to the method of hot water digestion mentioned above by substituting a beaker for the flask, and finally completing the mass to a certain weight, *i.e.*, 209·2 grammes, instead of volume. A definite weight of water, and therefore a fixed volume of water also, cannot be added to a normal or multiple thereof of shredded beet, unless it first be ascertained that the diminishing volume of the definite weight of beet, due to increased specific gravity of the constituent juice with rise of sugar percentage, is without influence upon the polarization within the limits of accuracy of the saccharimeter. The Kaiser-Sachs' modification of Pellet's instantaneous diffusion directs the weighing of a quantity of water, *i.e.*, 172 grammes, where a normal of pulp is used, into the counterpoised flask containing the lead solution. In a modification of this same instantaneous method by cold digestion, Fr. Sachs and A. Le Docte, while measuring 5 cc. solution of lead sub-acetate and 177 cc. water upon 26·048 grammes of shredded beet contained in a copper capsule, in effect use the principle of weighing.

If a strictly representative juice could be expressed from the beet it would be possible to ascertain its specific gravity and thus calculate the gross weight of pulp, lead sub-acetate solution and water necessary to complete the volume to 201·2 cc. for beets of different sugar percentages. Obtaining the total solids in the beet and from this subtracting the marc, while giving the real Brix or total solids in the juice, would not give the Brix by "spindling," having its equivalent in specific gravity, for well known reasons.

Ordinarily the quantity of lead sub-acetate solution to be used may vary according to the condition of the beet, whether it be fresh and normal or unripe, spoiled, frozen or has been preserved in silos. At the moment of adding the lead sub-acetate the chemist can scarcely be expected to detect any of these conditions and will be guided considerably by the season, by experimentation with various quantities and noting the effect of lead solution upon the clear filtrate. The first step in the investigation was to ascertain how much would be the weight of 52·096 grammes of pulp, 14 cc. of lead sub-acetate solution and water when mixed, digested, cooled to 20° C. (the average room temperature) and diluted to exactly 201·2 cc. Or if the weight varied, to establish that variation. Sixty-one individual analyses were made in the following manner. The weights of the clean, dry, 201·2 cc. flasks were carefully ascertained, and the capacities in Mohr cc. determined. These latter were found to vary between 200·76 cc. and 201·2 cc., which, while influencing the weight of the contents, and being of importance in the experiments, do not affect the polarization.

The several analyses were then made in the usual manner of the hot water digestion, the flask carefully wiped outside, and with its contents weighed and polarization made. The weight of the flask contents and the polarization were then corrected to 201·2 cc. capacity at 20° C. The weight of the flask contents was found to vary between 207·67 grammes (for 11·9% beets) and 210·08 grammes for 17·9% beets), with the average of 209·2. This latter may be taken, therefore, as the correct weight to which the mass may be adjusted in water digestion for beets in the receiving laboratory or for cossettes at the diffusion battery. It might be remarked here that the beets are purposely selected so as to get as many types as possible, as regards shape, size, degree of ripeness, sugar contents, and frozen. The selection represents the pick of 500 to 600 tons passing along the conveyor to the automatic scale.

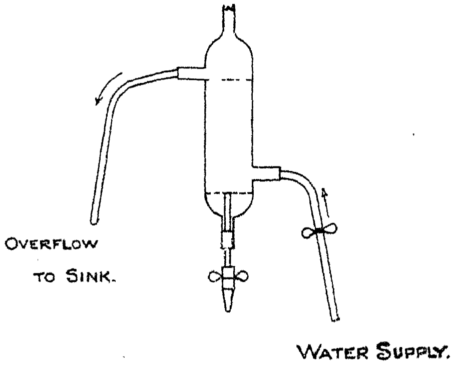
Upon the basis of the weights, corrected as above stated, a calculation was made to see how much the polarizations would have been affected had the weight at the end of the analysis been made up to 209·2 grammes in every case, *i.e*, to the average weight and a constant quantity. The differences, partly plus and partly minus, in some instances showed no variation at all, in others inappreciable, and in all cases, with beets containing less than 17% sugar, they were well within the limits of accuracy of the polariscope.

The average of the minus differences was 0·023%, and of the plus differences 0·03%, with the four most extreme results showing 0·09, 0·06, 0·06, and 0·79. In these four cases, as in 48 other analyses, single beets *only* were taken, while in the remaining nine analyses but two beets were united. This was for the purpose of detecting any great irregularities due to individuals. But in a receiving laboratory for cossette analysis where very many beets were united for one test, any peculiarities would sink into insignificance and show no eccentricities in variation.

The author has, therefore, dispensed with the use of a flask altogether in the analysis of beets and cossettes by the method of hot water digestion during the last sugar making season, substituting therefor a glass beaker, which is superior to a container of any other material because its weight can be kept constant.

Many thousand individual analyses to determine the purchase prices were made with accuracy, speed and cleanliness, and it was well demonstrated that from 600 to 700 analyses may be made by one chemist, one assistant and one wash boy in a day of ten working hours.

The preparation of the digestion beaker was as follows:—A quantity of 300 cc. Jena beakers was purchased, amounting to perhaps 200 in number, all were placed upon a balance, one at a time, and the heaviest selected. This was then provided with a $\frac{3}{16}$ in. tube of glass, sealed at both ends, provided with a rubber tip secured by copper wire, of suitable length to act as a stirrer. This heaviest beaker and its stirrer were then carefully weighed, and this weight was taken as the standard weight to which all flasks and their respective stirring rods were to be brought. A metallic counterpoise was then made. In preparing the stirring rods for the other *lighter* beakers, metallic mercury was introduced into the hollow stirring rods, previous to sealing, in amount sufficient to bring them all up to the standard weight, *i.e.* the weight of the heaviest and its stirrer, after which they were sealed. The beakers were then etched with consecutive numbers, and the stirring rods as well to correspond.



The plan for handling the samples was as follows:—After throwing the weighed pulp into the beaker, the weighing dish was rinsed free of traces of pulp into the beaker by means of an overflow pipette. This pipette can be home-made, and is best constructed from a glass condenser-jacket, as shown in the illustration, which practically explains itself. It is always filled to the same level, but the quantity drawn off is regulated at the lower dotted line by sliding the glass tube up or down. The quantity to be drawn off is first determined by experiment and should be sufficient in amount to allow for evaporation during the half hour digestion at 80° C. With the large bath in use this is a very uniform amount, and after cooling, from four to five drops addition of water completes the mass to 209·2 grammes, plus the weight of the beaker and stirrer.

Two baths are necessary, one for digesting and one for cooling, and each should accommodate five baskets of ten beakers each at one time. The baskets are best made of galvanized iron perforated with holes, provided with handles which act as hangers and have *double* brass wire strung across for separating the beakers, separated about three-eighths of an inch. These two wires, side by side, passing between each beaker, prevent clashing and resulting breakage. The bottom is lined with two-ply rubber, perforated.

The farmer's tickets accompanying the sample are placed in a tin case having a large brass number soldered to it, and a corresponding number is upon a basket. The basket placed with number facing the chemist, is filled with beakers in a *certain* order, and the sample tickets are slipped into the corresponding tin box in a similar order or arrangement.

After digestion and cooling, the beaker is wiped outside (or allowed to drain and dry) and placed upon a balance, and with the contents brought with a few drops of water to the desired mass, *i.e.* 209·2 grammes plus the counterpoise. The analysis is then completed as usual.

This method will of course apply to sugar cane and bagasse analyses, where, weight being applied instead of volume, the quantities may be proportionately increased and the difficulty in sampling thereby overcome.

SOME HAWAIIAN SUGAR FACTORIES.

I. The Hawaiian Sugar Company.

The Hawaiian Sugar Company, Limited, control one of the prosperous plantations on the island of Kauai, with headquarters at Makaweli, where the first cane was planted, under the co-operative system in the nineties by the present Company.

The total area is approximately 6,500 acres held under long lease from Gay & Robinson, and extending from Waimea gulch to Hanapepe valley, a distance of several miles.

Practically the entire area is under cultivation, and planted principally with the Lahaina cane, although a small area is given over to Caledonia, Striped Singapore, and Rose Bamboo canes. About 40% is plant and 60% ratoons.

The land has a gentle slope from the sea, the soil being a reddish loam, carrying pyroxide of iron. Soil is prepared for planting by three sets of Fowler steam tackle. Cultivation is by fertilization and irrigation.

The water supply for irrigation purposes is obtained from the Olokele and Hanapepe valley streams, the water flowing to all of the lands by gravity.

Work upon the Olokele ditch, which is the largest engineering scheme of the kind ever undertaken in the Islands, was begun for the Hawaiian Sugar Company by M. M. O'Shaughnessy and his assistants, Messrs. McLennan, H. C. Smalley, and Guy F. Rankin, in 1902, and was completed in 1904 after a vast amount of tedious labour.

The ditch is about 14 miles long and traverses a rough, mountainous, rocky, and picturesque country overlooking the beautiful Olokele stream, which winds along over its rugged and rocky course many hundreds of feet below. Several lives were sacrificed before the huge task was completed. Japanese labour was used upon the construction work.

The Olokele stream is a branch of the Makaweli stream, which is a tributary of the Waimea river. The head of the ditch is located far in the mountains where a small dam of rocks has been built, causing nearly all of the Olokele stream to turn from its course and flow through four iron-grated intake tunnels into the main ditch, which conveys this large stream of water through several miles of rocky tunnels, out into an open country where the altitude is about 1000 feet, thus allowing the water to be taken by numerous branch ditches to every portion of the plantation. The capacity of Olokele ditch is 60,000,000 gallons in 24 hours. During September, 1905, the ditch was supplying the plantation with 40,000,000 gallons per day, while the Hanapepe stream was furnishing 35,000,000 for the same length of time.

Olokele ditch cost $350,000. Since its completion, by planting 1,500 acres of new lands to cane, and increasing the output of the old lands, the Hawaiian Sugar property has become the banner plantation of Kauai.

The method of transporting cane to the mill is by a complete railway system, which consists of some 20 miles of main and portable field tracks. The equipment comprises nearly 500 cane cars having an average capacity of from three and one-half to four tons of cane. Three Baldwin locomotives handle the cars. Five and one-half miles of new trackage is under construction.

In the development of the property 2,200 skilled and unskilled labourers are employed, who occupy several camps adjacent to their work, where have been erected better houses and better camps for the accommodation of the men and their families than are found upon the majority of plantations.

The labourers receive in addition to their wages, which average $20 per month, house room, fuel, water and medical attendance, and have little patches of land where they raise vegetables.

The labour incident to the successful operation of this plantation is handled under two systems, one-half of the labour working under a co-operative or profit-sharing system, and known as company men or contractors; the balance are day labourers, paid a regular rate per month of 26 working days.

About 260 mules and horses are required in the general plantation work, which are given excellent care. Working cattle are used to some extent.

The average yield of sugar from all cane fields now under cultivation is between six and seven tons to the acre, but the plantation has had fields that yielded much heavier. Cane grows to an immense height upon some of the tablelands near the Hanapepe valley, and ranks with any raised upon the Island of Kauai.

The old diffusion mill at Makaweli, which was the only one remaining within the territory, was used for the last time in taking off the 1905 crop. A large 12-roller mill has been recently erected in its place by the Honolulu Ironworks, and is grinding the 1906 crop. This new mill, driven by two Hamilton-Corliss engines of 300 horse-power each, bears the distinction of being the largest single mill in the Islands, though Ewa and Hawaiian Commercial both have two 9-roller mills each. One engine drives the two remaining mills and the crusher. An Atlas engine drives the 18 knives, for chopping the cane, and the unloader which takes cane from the cars as they stand at the mill. Eight multitubular boilers of 175 horse-power each, furnish the power which drives all mill machinery. Cane trash and low-grade molasses are turned into the furnaces.

The mill is supplied with the Deming apparatus, one 20 and one 30-ton vacuum pan, twenty 30-inch Watson-Laidlaw centrifugals, six 40-inch water-driven centrifugals, a 15-ton travelling crane for handling heavy machinery, a 300-light Westinghouse electric plant driven by water-power, and much other machinery. The bagasse from the batteries is fed by an endless carrier to a roller mill for the purpose of extracting the water, and is then fed automatically to the furnaces. The mill extraction will be 95% by this system.

In place of diffusion, settling tanks, mud presses, and the Deming system of clarification are used. Maceration is accomplished by utilizing hot water from the mud presses, which will be under complete chemical control. All cane brought to the mill is weighed upon the cars and then sent to the unloader, which dumps it into the carrier, and it is then sent to the Krajewiski crusher.

The mill building is steel framed, covering an area of 102 × 65 feet, and has galvanized iron roofs and sides. Connected with the mill are the machine and blacksmith shops, where all repair work is done. Adjacent to these is the locomotive round-house. The Company operate their own ice and electric plant, the entire mill and grounds being supplied with a system of incandescent lights.

In 1904, 13,000 tons of sugar was the output, while in 1905 the amazingly large amount of 21,200 tons was taken off. The estimated crop for 1906 is slightly over 20,000 tons, while in 1907, 22 or 23 thousand tons are expected.

II. KEKAHA SUGAR COMPANY.

The Kekaha Sugar Company's estate consists of Territorial and former Crown land leaseholds under sub-lease from the Knudsen Estate upon shares. It extends from Kekaha to Polehale, a distance of twelve miles, varying in width from one-quarter to three-quarters of a mile. This plantation ranks as one of the prosperous properties on the Island of Kauai.

The first cane was planted on these lands by Capt. C. L'Orange in 1878 and was all of the Lahaina variety. In 1880 A. Faye and W. Meyer bought L'Orange out and harvested the first crop. H. P. Faye, the present manager, began planting in 1883 at Mana, where the most extensive portion of the present Company's holdings are now situated.

The Kekaha Sugar Company, Limited, was formed in 1898 and now controls an area of 23,000 acres, nearly all of which is planted in Lahaina cane. New Caledonia cane is now being tried upon a small scale, as it does not seem to be so susceptible to the ravages of the leafhopper as the Lahaina variety.

The soil is deep, red loam, black adobe and marsh lands. The average annual rainfall is so limited that irrigation from artesian wells is necessary. The total rainfall for 1903 was 9·85 inches while during the first eight months of 1905 but 2·78 inches was recorded. Four pumping plants fitted with five Risdon high-speed pumps with an average daily output of 22,000,000 gallons are in use, also an electric pump driven from the mill and using trash for fuel when the mill is running.

The cane is planted at elevations ranging from twenty-five to ninety feet.

The 1905 crop was from 600 acres of plant and 720 acres of short and long ratoons, the total sugar output of the mill being 8,100 tons. In the cultivation of the soil from 1,500 to 1,800 pounds to the acre of high-grade fertilizer and nitrate of soda are used. This greatly stimulates the growth of the cane.

Cane is transported from field to mill by rail, there being four miles of portable and some fifteen miles or more of permanent trackage. Five miles of the latter is of double track. The rolling stock consists of two large Baldwin locomotives, 400 cane cars with an average capacity of 2½ tons each, and sixteen sugar cars.

The plantation employs 956 skilled and unskilled labourers, most of the work being carried on by day labour, with the exception of cane cutting and loading, which is done under the contract system.

The labourers in addition to their wages receive house room, fuel, water and medical attendance. The plantation does not maintain a hospital of its own, but contributes to the support of the Waimea hospital, of which the various plantation managers of the district are trustees. The Company also support the foreign church of Waimea.

The nine-roller mill consists of three 3-roller mills made by the Honolulu Iron Works a few years ago. The rollers are 32 × 60. The cane is fed through a Krajewiski crusher. The hydraulic pressure upon each 3-roller mill is as follows, varying somewhat according to the fibre of the cane, &c.:—No. 1 mill, 250 tons; No. 2 mill, 275 tons; No. 3 mill, 300 tons. Formerly the mill was operated seventeen hours a day, during which time from forty to forty-five tons of sugar were turned out. In consequence of many new and efficient improvements made from time to time the mill can run night and day, and during a continuous run of twenty-two hours make from seventy-five to eighty tons of sugar.

The principal mill apparatus consists of two quadruple effects, six filter presses, one Honolulu Iron Works and one German vacuum pan, and a pan recently installed by Mr. Lorenz with a total striking power of eighteen tons, thirteen centrifugals and the necessary pumps and other appliances.

Sugar from this season's cane crop was made with the aid of a new central condensation system recently put in by Consulting Engineer Lorenz. This system consists of one central condenser and one vacuum pump, to which two quadruple effects and three vacuum pans are connected. This condenser and pump does the work formerly done by five vacuum pumps. The new vacuum pan contains a number of 1½ inch straight tubes, the boiling being done by exhaust steam only. The pan and condenser were the first of the kind to be used in the Islands, but there are others now in the course of construction for different plantations.

This condenser, among other favourable qualities, is a fuel saver and has been an immense success in every particular. It apparently is a valuable adjunct to the mill and has materially increased the sugar output.

The mill is driven by a large Hamilton-Corliss engine, steam being generated by the burning of bagasse or cane trash and molasses. Water for condensation purposes is obtained from artesian wells on the place.

The Company owns its own lime kiln, the lime being used for clarification and building purposes, &c.

Adjoining the mill building are the machine shops, electric light plant and general offices of the Company. In addition, the Company maintains its own telephone system, using portable instruments. Only one grade of sugar is manufactured, known as the "A" grade, all the low-grade sugars and molasses being worked over.

The sugar product when ready for shipment is conveyed from the mill to the landing at Waimea by rail, whence it is shipped to Honolulu by steamer and loaded there direct into vessels for the Pacific Coast and the East.

H. P. Faye is manager of the plantation and has been actively identified with the sugar industry for the last twenty-five years.

III. THE MAKEE SUGAR COMPANY.

Located at Kealia, on the Island of Kauai, are the large plantation holdings of the Makee Sugar Company, comprising an area of 27,802 acres, 18,337 acres leasehold and 9,465 fee simple. The Anahola, Kamalamaloo, and Kapaa lands are owned by the Territorial Government, the leases upon them expiring in May, 1907. The plantation is awaiting the Government's decision as to whether the sugar company will be allowed to lease these lands again. Some portions have not been replanted with cane this year for this reason. The lease upon the Government portion of the Olehana lands expires in 1909, while the lease upon the part owned by private individuals will expire in 1913. Should the Government refuse to lease the lands to the plantation again, about half of the plantation labour will be discharged, as the same number of men will not be needed upon the Kealia and Waipouli lands, which are owned in fee simple.

Capt. James Makee first planted cane upon the present site of the holdings of the Makee Sugar Company in 1877, but soon sold out to Col. Z. S. Spalding, who really developed the plantation.

At the present time the company has under cultivation 6,500 acres. For the 1905 crop there was of plant cane 163 acres, long ratoons 1,124 acres, short ratoons 180 acres. The total for the 1906 crop comprises about 2,384 acres. About 2,267 acres will be carried for the 1907 crop.

The cane is mostly of the Lahaina variety, but 200 acres of Caledonia have been tried. The general character of the soil is swamp, yellow and red, the last mentioned carrying oxide of iron as a base.

For ploughing, two 16-horsepower sets of Fowler's steam tackle are in use, the soil being turned over to a depth of from fourteen to sixteen inches. For ordinary ploughing for long ratoons, mule-power is used, breaking the soil up, putting fertilizer in and "hilling" up. In fertilizing, from 600 to 1000 pounds to the acre of a variety of high-grade fertilizer are used, varying, of course, according to the soil and season. The cane matures in from sixteen to eighteen months. Cane planted from June to October tassels the following October.

The average annual rainfall in this section of Kauai is thirty-six inches. The main water supply for irrigation purposes is from mountain streams, being led off from the main source by a system of ditches to large storage reservoirs constructed at stated intervals upon the plantation lands, from whence the supply is distributed to the cane fields. At the present time these reservoirs have a capacity for storing 200,000,000 gallons of water.

Cane is carried to the mill by a system of main and portable railways. The aggregated length of the main line is 35 miles with six miles of field or portable tracks. The rolling stock consists of 400 cane cars, 12 double-truck flat cars for freight, 40 other cars and four locomotives of the Baldwin and German types.

Four artesian wells located at Kealia, with a capacity of 4,000,000 gallons of water in 24 hours, are used to supply water to a height of 250 feet in order to irrigate the lands lying above this level. The artesian well water is pumped by means of electrical power generated by dropping the mountain water 400 feet, which water is afterwards used in watering cane lands between the 250 and 500-foot level.

Some of the fields have been planted consecutively for twenty-eight years. The average number of tons of sugar produced to the acre is as follows:—Plant cane, 4·10; long ratoons, 3·61; and short ratoons, 1·78. The tonnage per acre has fallen off considerably lately because of the leaf-hopper pest which probably has lessened the yearly sugar output 15%.

The company employ about 1000 labourers, the majority of whom are unskilled hands or field labourers, paid an average of $18 per month of twenty-six days. A few men are engaged under the co-operative system. The labourer, in addition to his regular pay, receives free water, fuel, house and medical attendance.

The sugar output for the season of 1905 was 8,335 tons and the 1906 crop will be about the same. The plantation property extends from near the Wailua river to the Moloaa lands, a distance of eight miles along the sea coast.

The old diffusion mill at Kealia, which was the first one in the Islands, was superseded in 1900 by a new maceration process mill, which is a good 9-roller plant, each mill of three rollers being 34 × 72 inches, made by the Honolulu Ironworks Company, and having a capacity for grinding 800 tons of raw sugar. There is a pressure of 375 tons upon No. 1 mill, 400 tons upon No. 2 mill, and 450 upon No. 3. The various mechanical appliances required in a sugar factory have been installed by the Kilby Manufacturing Company of Cleveland, Ohio, consisting in the main of a complete superheating clarification system with continuous settling tanks and extensive sand filtration system, through which the light and heavy juices are filtered (the sand carrying a large percentage of lime), evaporators of the Wellner-Jelinek type, ten 40-inch belt-driven centrifugals of the Weston type, eight crystallizers with a capacity of 30 tons of masse-cuite, and two Kilby pans with capacity to strike 35 tons of sugar.

Everything about the mill has been arranged so as to enable the engineer and sugar boilers to have a complete view of the machinery at all times. Operated directly overhead in the mill is a large travelling crane capable of moving a 25-ton weight. The bagasse is conveyed by carriers to the fuel room, and fed automatically to the furnaces by aid of "Yankee Feeders." Some coal is burned, also a lower grade of molasses. The mill extraction of sucrose in cane, according to condition of cane, is from 93 to 95%. The mill is supplied with several filter presses, the mud from which is used for fertilizer.

Adjoining the mill a large warehouse has been erected with a capacity of 100,000 bags of sugar in case of emergency. Both mill and warehouse are constructed of skeleton steel with corrugated iron roof and walls. Independent of the main mill-power there has been installed supplemental power for operating the ice-making plant, which has a capacity of turning out three tons of ice per day. By this auxiliary power, when the mill is shut down, the machine shops can be kept in operation. This will soon be replaced by electrical power from the mountains.

A 500-light electric plant has been installed with a Bullock dynamo, operated by a Ball engine.

The Company makes but one grade of sugar, known as the "A" grade.

The Territorial Government having notified the Makee Sugar Company last fall that it would neither lease nor sell the Kapaa lands but would like an immediate release of them in order to dispose of them to a Molokan colony, arrangements were made to give up the unexpired time of the lease, and the Molokans bought the growing crops of cane on Kapaa at exact cost to the Makee Sugar Company, and made a grinding contract for a term of three years, giving the Molokans 8 lbs. of sugar for every 100 lbs. of Lahaina cane delivered into the Company's cane cars in the field, said sugar being delivered bagged at Anahola. This is said to be the most liberal grinding contract made with any planters in Hawaii.

About 250 acres of rice land is rented by the Makee Sugar Company to Chinese. Upon the plantation are 170 head of mules and about 1000 head of cattle, the latter being raised for beef that is entirely consumed upon the plantation. The Company slaughters from twelve to fifteen head per month. Some 350 calves are branded annually.

At Anahola the Company have excellent facilities for shipping the sugar product to Honolulu. The Company conduct their own store at Kealia, which is a large one.—(*Hawaiian Evening Bulletin.*)

A NEW METHOD FOR SUGAR REFINING.

A new method for sugar refining has of late attracted some attention, and as it has had a practical trial a description of the Caille process is not without interest. Upon general principles our readers are aware that the art of sugar refining consists in removing all impurities and colouring matter a raw sugar may contain; the final product should be very white and delivered to the consumer in various forms as the occasion may demand. If the operation begins with a white crystallized sugar the impurities may be removed through the use of suitable sieves assisted by a well-arranged ventilation. As for the colouring substances, a large portion of these are introduced during the process of refining; when heating saccharine solutions there are always certain colouring matters formed; this is also true during the mechanical manipulations. The process under consideration has for its object the reduction to a minimum of the quantity of colouring substances formed during the process of refining, and by this means to simplify the operations of existing standard methods. The white crystallized sugar is brought down to a given size through a series of siftings, the impurities are at the same time removed by fanning, and the sugar thus obtained is diluted in cold water; this operation should be rapidly done in a vertical mixer; the arms of the mixer are of a special construction, and during their rotation one part of them describes a cone with its apex pointing upwards, and in the other the apex cone is pointing downwards. The fluid mass is run into special moulds consisting of boxes open at both ends; these may be readily arranged in series and placed in a double-bottomed receptacle or crystallizer; there is a filtering side through which the syrup may pass out and the crystals be retained, the saturated syrup remaining between the sugar crystals soon crystallizing. It is to be noted that the crystallization occurs upon the edges of the broken crystal, consequently it is concluded that the fracture is a nucleus of crystallization. It is claimed that the most fluid portions are the first to run off, and as time progresses become more and more dense and increase in purity, consequently there follows a super-saturation through the natural flow. There is not only crystallization, but also purification owing to the fact that the most coloured syrups were the first to be separated. The expert of the Sugar Manufacturing Syndicate of France by special request visited the Saint-Erme refinery and gave an account of what he saw. A few words relating to same will make the process much clearer in our readers' minds. The sugar is first crushed, is then raised by an endless band into a sieve which classifies the grains according to their size; there follow three classifications, the last consisting of lumps which are again crushed. The sugar of each class is dissolved in water at the ambient temperature. To this 13% of water is added, and about 3 grams. of blue per 100 kilos.

of sugar; the mixing is done in a special vertical mixer. At the bottom of the apparatus there is collected a thick syrup that has been prepared without the addition of any hot water, this paste is run into suitable moulds which consist of galvanized iron boxes, sliding one into the other.

These boxes are 12 cm. in length, 9 cm. wide, and have a spacing between them of 15 mm., which determines the thickness of the bars to be obtained. These are placed one the side of the other on a linen band which acts as a filtering medium; they are then filled with the sugar paste, so that the mass may flow in every part of the mould. It must have a certain fluidity; it must not, however, contain too much water as the yields of sugar in bars would become much lessened. It is important to note that the sugar in dissolving always liberates heat and will cause a fall of temperature, and when passing through the mass will produce a super-saturation of the mother syrup. After 30 to 48 hours the mass in the forms becomes solid. After the draining has continued for several more hours the moulds are placed in series of 8 to 10 in the same receptacle; these are placed in an ordinary centrifugal, the syrup is separated after a period of 10 minutes, in a machine revolving at a velocity of 1300 revolutions per minute. At the refinery under consideration the syrups from the drippings and from the swing-out operation are combined; they have a slightly blue colour owing to the blue added. They are filtered and may be readily sold. The bars are dried in suitable ovens. At the Saint-Erme refinery there may be handled 2000 kilos. of sugar per diem. The practical experiments made thus far prove beyond cavil that the plant needed for this method of refining demands a very limited money outlay.—(*Sugar Beet.*)

THE SUGAR INDUSTRY IN PERU.*

It would be hard to find anyone more competent than Professor T. F. Sedgwick to supply information regarding the Peruvian sugar industry. His long residence in that country, and his connexion with the Cartavio Estate, should ensure his knowing all the salient features of the local sugar industry. This knowledge he has lately set forth in a small book published in Peru, which should be procured and read by all those who desire to learn what the procedure is in this somewhat remotely situated sugar country. We are indebted to this excellent little work for the following details:—

Peru lies within the tropical zone; and is split into two agricultural divisions by the Andes, which run parallel to the coast and some miles from it. The east side is the wet one and is a land of jungles and rains, and has not yet been fully exploited. The principal area where sugar is grown is along the Pacific Coast strip. Numerous spurs of the Andes run out to the sea, forming valleys of great extent. These are watered by rivers which have a flood and a short season. It is the flood waters that have aided in forming the productive agricultural lands.

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* RELATING TO THE SUGAR INDUSTRY IN PERU (*with special mention of Hacienda Cartavio*), by THOMAS F. SEDGWICK. 77 pp. demi 8vo. Trujillo, Peru: Imp. Haza, Verjel & Cia, 1905.

The climate is not, considering the geographical situation, a truly tropical one. Cold ocean currents from the Antarctic regions and the proximity of the snow-clad Andes have their influence. The rainfall is very small, and the principal cane-producing valleys depend on irrigation for their water supply. The soils vary from very fine sandy loam to silty. As a whole they are deep soils, and their physical composition renders them very retentive of moisture. As regards chemical composition they are of the alkali type, some of them containing a considerable amount of water-soluble chlorides, sulphates, and carbonates. Lime is often present in high proportion. Nitrogen is good, but exists in variable quantity. These valley soils are, in fact, naturally rich in plant food, retentive of moisture, easy of cultivation, and capable under proper treatment of great productiveness.

An old book on Peru informs us that sugar cane was not known in the country at the time of the conquest by Pizarro. It was in 1570 that they had the first plantation, and they had at first to compete with Mexican sugar, but by clever dealing, the latter product was ousted in favour of the home grown one. The modern industry dates from 30 or 40 years ago when several small estates were established, each having its own factory and organization. The machinery was procured from Europe and the United States. Some of these factories were not only splendidly but elaborately furnished, and some of their features would be considered quite modern at the present day. Such a policy of elaboration was easy as sugar fetched a good price and money was consequently plentiful. But when prices went down, some of these estates had to suspend work. The present tendency is all in favour of large estates and central factories. A few of the biggest estates existing at present have an area of over 15,000 acres, of which perhaps half will be in cultivation.

Where central factories work in conjunction with small cane growers, various arrangements exist between the planter and the factory. The former delivers his cane to the factory and receives as his pay 65% of the value of the sugar and alcohol produced. Some factories attend to the cutting and transport as well, and receive 50 to 50% of the profits as their share. Another arrangement gaining in favour is for the factory to buy the cane on the basis of a sliding scale which latter is controlled by the Beaumé of the juice and the prevailing market price for sugar at Liverpool.

A form of native sugar much in demand is called *Chancaca.* It consists of sugar boiled down in open pans, run into open moulds six inches in diameter and allowed to cool. It is then tied up in cane leaves and placed on the market. Some factories made nothing else. The original factories were fitted with three-roller mills, open juice evaporators, small pans, under-pulley centrifugals, masse-cuite cars, &c.

The bulk of the labourers are drawn from the natives, descendants of those who peopled the country in the time of the Incas. Attempts to introduce Chinese labour have met with only partial success, and the latest movement to increase the labour supply has been the introduction of Japanese; but opinions differ as to their value. The estate labourers are obtained in general through contractors, who go to the mountains to engage them. These agents likewise pay the labourers their wages. The latter live quite comfortably and independently, but must conform to the regulations of the estate. The larger estates make up a settlement of from two to three thousand persons. A physician is retained whose services are gratis. Hospitals, drug stores, schools for the children, and a market are all provided. On most of the estates as much of the work as possible is done by the task or *tarea;* such work as cane-cutting, loading, planting, and weeding are done in this way. The system is so well organized that it works very well.

The cane lands are mostly gentle slopes, so that machinery can be used in preparing them. Steam ploughing is employed to turn up the soil, the fields being ploughed and cross-ploughed till they assume the appearance of a chess-board. The cane furrows are laid off in parallels of between three and four feet. The cane tops are brought direct from the fields, where canes are being harvested, on cars and left on the ridge of the furrows; the planting gang then lay them horizontally in the furrow, and cover them with a few inches of soil. Water is then turned on from the irrigation ditches and the cane left to sprout.

When the cane is about a foot high, the first weeding is done, and the field is then kept clear of weeds till the cane leaves have grown large enough to shade the ground. The young cane is allowed to grow for from eighteen months to two years, according to the locality, soil, and weather conditions. Some weeks before harvesting the water is turned off the field and the cane allowed to ripen. When the first ratoon cane is a few feet high, the field is refurrowed, so as to make the plants grow in the ridges and the irrigation water to flow in furrows between the rows of cane. The canes are re-cut from three to six times according to their yield.

The chief fertilizer used is the native guano, which is put in the furrows either when planting or when the cane is a few months old;

sometimes the guano is mixed with bagasse ash. A few planters also use lime and gypsum.

The three chief varieties of cane used are the white, the greenish yellow, and the red purple. The last-mentioned one is not so extensively grown as the others, but is suitable for certain alkali soils.

On some lands, under very favourable conditions, it will probably be found that 90 tons of cane per acre can be grown on small areas and that some estates can yield an average of 60 tons, this, of course, under intensive cultivation. But the average for good estates is probably from 35 to 45 tons per acre.

The figures below give a fair idea of the composition of some average Peruvian canes:—

Sucrose in cane %	15·77
Fibre in cane %	15·00
Moisture in cane %	66·02
Density of Juice: Brix	20·87
Sucrose in Juice %	18·71
Purity of Juice	89·68
Ash in Juice	0·47
Gums in Juice	0·45
Tons of cane per acre	40·00

Irrigation is a most important feature in the culture of the canes. The irrigation waters are led from the river to the land by canals. From these the water passes through ditches to the different sections, where it is run into the cane furrows. As the rows are parallel and slightly sloping, the water flows freely across the fields; much less water is used than is the case in Hawaii, as the soils are less porous and underground water exists near the surface. The amount of water used by each estate is regulated by law, and a Water Commission exists to settle disputes.

The cane is harvested by gangs of men armed with machetes. As this work is paid for as piecework, some of the cutters get very skilful. Portable main tracks are laid down to the sections which are being cut, and from these branch rails are run into the field. On these, cars drawn by oxen are run, and on reaching the main track the train is taken to the factory by a locomotive. The cars vary in capacity from two to ten tons. On reaching the factory they are unloaded by hand. At Cartavio 26 men are employed to unload 400 tons daily.

The following is a fair description of the methods of manufacture employed by the best factories. The cane after being weighed is run in cars alongside the automatic feeder, whence it is led up to a dry double crushing plant of two 3-roller mills fitted with hydraulic pressure. The cane after passing through the first set of three rolls is run up to the second set, passed through, and then the bagasse is carried off by a special conveyor to be dried or else to the furnaces direct. The juices from the two mills are led through pipes to a common well. Each mill has its own engine; in some cases these are of the "walking beam" type. The speed of the mills is about 22 ft. per minute for the first mill, and 11 ft. for the second. The extraction of juice over weight of cane varies from 62 to 70%. Cane that will give a juice of 23 Brix and 21% sugar, will give an extraction of 62 to 64%.

The juice is pumped from the wells into double-bottom copper defecators of 400 to 500 gallons capacity. There it is limed to a neutral or slightly alkaline point, and tempered. After defecation the juice is drawn off, clarified, filtered, and then run into the tank feeding the triple effet. The deposits are delivered to the filter presses and this filtered juice also goes into the triple effet tank. After evaporation the juices are discharged at 24 to 30° Beaumé into eliminators which are fitted with copper coils. They are skimmed, allowed to settle and then drawn off to the vacuum pan tanks. The analysis of a 1st syrup gives: Brix, 52·86; sucrose, 47·8; glucose, 1·83; purity, 90.

The vacuum pans, often of copper, hold from 10 to 15 tons; the boiling of the mass takes from 4 to 8 hours. The strike is discharged at about 94° Brix. An average first masse-cuite gives the following analysis:—Brix, 93·24; sucrose, 83·4; glucose, 3·90; purity, 89. The masse-cuite is discharged into cars holding about a ton each, which are run out to cool for from 10 to 24 hours. It is then centrifugalled at about 1,000 revolutions per minute for 4 to 10 minutes. The yield of 1st sugar over weight of masse-cuite is 60 to 64%.

The sugar is then transferred to a drying room where it is spread on the floor for several days with occasional turnings, after which it is ready for bagging. The 1st sugar is from medium to large grain and polarizes about 96·5° to 98°. The 1st molasses yield the following average analysis:—Brix, 75·18; sucrose, 52·80; glucose, 7·01; purity, 69.

The molasses is generally used in the manufacture of alcohol. The revenue from this commodity is considerable, being based on the per cent. of pure alcohol in the commercial product.

The following data (in some cases only approximative), giving the working details of one representative sugar factory, will sufficiently illustrate the type of sugar house work found in Peru:—

One dry double crushing plant. Three-roller mills, cylinders 32 in. by 78 in. Mills propelled by separate engines of the "walking beam" type, and fitted with hydraulic pressure apparatus. A registering balance used. Five hundred tons of cane ground per diem.; rate, 33 tons per hour. Average extraction, 68. Speed of mills—first mill, 22½ feet per minute; second mill, 18½.

System aims to secure juice with density as high as possible (this depends on the manipulation of the water and the time of cutting). Average purity of juice, 87. Double-bottom copper defecators used; juices limed to alkalinity, 8 to 10 lbs. of lime per defecator. Juices filtered. No juice heater used. Juice run direct from defecators to presses. No sulphur or other chemicals used in juice. Defecation, 35 to 45 minutes' duration. Total evaporating surface of triple effet, 4,500 sq. feet. Vacuum of first chamber of triple effet, 8; of the second, 18; and of the third, 27. 19,800 litres of juice evaporated per hour at 12 to 35 Beaumé.

Vacuum pans of copper. Strike boiled off in 3½ hours. Pressure on pans, 40. Vacuum, 28 in. Second sugars grained in pan, third and fourth boiled to string. First masse-cuite discharged from pan at 93 to 95 Brix, and into cars of 1¾ tons capacity. Analysis of first masse-cuite:—Brix, 93·55; sucrose, 83·66; glucose, 3·09; purity, 89·42; ash, 1·90. Masse-cuite cooled as follows:—first masse-cuite, in 12 hours; second, in 4 hours; third, in 5 days; fourth, in 20 days. First and second masse-cuites centrifugalled at about 37°C.; third and fourth, cold. Masse-cuite in cars dumped by hand dumper into mixer in reservoir, the cars being raised to upper floor by an elevator. Battery of eight overhead-pulley Weston 30 in. centrifugals, 1,200 revolutions per minute. All sugars worked in same battery. Sugar from centrifugals discharged from below on to an apron. Time for centrifugalling masse-cuite:—first sugar, 3 minutes; second sugar, 7 min.; third sugar, 11 min.; fourth sugar, 17 min. Recovery of sugar over weight of masse-cuite:—first sugar, 63; second sugar, 52; third sugar, 35; fourth sugar, 28. Sugars dried on floor. Polarization:—first sugar, 97·80 to 98; second sugar, 93 to 94; third sugar, 89 to 91; fourth sugar, 87 to 89. Yield of sugar over weight of cane:—first sugar, 8·11; second sugar, 1·97; third sugar, 0·60; fourth sugar, 0·25. Average yield of sugar over weight of cane, 10·94. Sacks hold 225 lbs. avoird.

Ten boilers, two tubular and remaining eight of old type. Excess of fuel, only 50 to 60% of bagasse being used. Bagasse dried and fed by hand.

Cane irrigated once in three or four weeks. Guano, lime, ashes, filter-press cake, gypsum, sulphate of potash, nitrate of soda, all used. Over 7,000 acres of cane. Estate situated in middle of valley.

170 men employed in the factory during 24 hours. Sixteen men unload cane at conductor.

THE EXTERMINATION OF MOSQUITOES.

The following rules for preventing the mosquito plague are adapted from the United States *Bulletin*:—

1. Mosquitoes breed *only* in water; usually standing water in artificial places, not running streams.

2. Mosquitoes occur in the vicinity in which they breed. Invasions from long distances are exceptional.

3. The young mosquito, or "wriggler," lives in water at least 10 or 12 days.

4. Although the wrigglers live in water, they *must* come frequently to the surface to breathe.

5. Kerosene oil on the surface of the water prevents the wriggler from breathing.

6. Destroy the breeding places and you will destroy the mosquitoes.

7. Empty the water from all tubs, buckets, cans, flower pots, vases, &c., once a week.

8. Fill in or drain all pools, ditches and various excavations, such as post holes left unfilled, &c.

9. Change regularly all water needed in chicken-runs, yards, &c.

10. Treat with kerosene oil all standing water which cannot be screened or drained (1 oz. of oil (two tablespoonsful) will cover 15 square feet of surface). The oil does not affect the water for use if the water is drawn from below.

11. Put wire netting over cisterns, wells and tanks of water in every-day use.

12. Places in which it is undesirable to place oil, such as watering troughs for stock, ponds, &c., can be kept free of the wrigglers by putting in gold fish. The nymphs of dragon flies and tadpoles of frogs also feed on the wrigglers.

13. See that the plumbing about the place is in perfect order. Prevent leakage of pipes or clogging of eaves and gutters.

14. Inspect all cesspools and see that the covers are *absolutely* tight.

15. Clean away all weeds, grass and bushes about ditches, ponds, and other possible breeding places, since these afford a hiding place for the adult mosquitoes.

16. Clean up vacant lots and back yards of all cans, tins, bottles, and rubbish.

17. First do away with or treat all places where mosquitoes are known to breed, and then begin to work on places where they might breed. Remember that large quantities breed in wild pines, hollows in trees and in banana leaves. Keep the vegetation low near the house.

18. As a citizen of your community you should feel a personal responsibility for the destruction of the mosquitoes in your district, and seek to co-operate with your neighbours in the work of doing away with breeding places. Inspect and treat with kerosene-oil,

gutters, culverts, ditches, man-holes, catch-basins, &c., along the roadside. Man-hole covers should be screened.

19. Where oil is applied to standing water it must be distributed evenly over the surface. Use a hand syringe, or, if the area is great, a knapsack sprayer.

20. Houses should be cleared of all winged mosquitoes by the burning of insect powder. The mosquitoes will fall to the floor, and should be collected and burned.

21. Relief in any community or district depends entirely upon the co-operation of the members of the community.—(*Bull. Dept. of Agriculture, Jamaica.*)

STATISTICS OF SUGAR IN SWITZERLAND, 1905.

In a number of the *Sucrerie Belge* M. Sachs gives the following as the quantities of sugar imported into Switzerland during 1905, expressed in quintals (1 quintal = 100 kg. = 220 lbs.):—

Country of origin.	Raw sugar, crystallized, crushed, glucose, &c.	Loaf or block sugar.	Cube sugar, pieces, powdered.
Austria-Hungary	262,976	79,156	50,139
Germany	180,256	20,717	57,385
France	121,578	55,462	33,024
Russia	5,634	—	—
Belgium	3,637	—	—
Various	984	—	—
Total	575,065	155,335	140,552
In 1904	514,756	157,870	123,178

Exports and imports of chocolate have been—

	Quintals.	
	Exports.	Imports.
United Kingdom	28,011	6
U.S.A.	9,463	—
Germany	7,693	217
France	7,117	27
Italy	6,230	10
Belgium	3,873	—
Russia	3,493	—
Austria-Hungary	1,553	—
Holland	1,254	2
Various countries	8,077	—
Total	76,764	262
1904 Total	67,809	214

CONSULAR REPORTS.

JAPAN.

There was a very great decline of £952,000 in the value of the sugar importation into Japan during 1905. In the case of sugar below No. 15 D.S., the figures were £1,839,000 and 1,331,000 in 1904 and 1905 respectively, while in refined sugar the decrease was even more marked, the imports totalling £511,000 in 1904 and only £67,000 in 1905.

The countries participating in the sugar trade, together with their respective shares, were as follows:—

Year.	Value.						
	Dutch Indies.	Phillipine Islands.	Germany.	Austria-Hungary.	Hong-Kong.	Russia.	Total Imports.
	£	£	£	£	£	£	£
1905..	1,212,000	29,000	31,000	..	62,000	2,000	1,400,000
1904..	1,502,000	171,000	119,000	19,000	224,000	202,000	2,352,000
1903.	975,000	294,000	283,000	255,000	157,900	16,000	2,140,000
1902..	579,000	105,000	332,000	117,000	237,000	200	1,476,000
1901..	280,000	277,000	899,000	415,000	1,110,000	..	3,419,000

There are several reasons to account for this great decrease: firstly, the market at the commencement of the year was over-stocked in consequence of speculative purchases made in anticipation of the special consumption taxes which were levied from January 1st, 1905; secondly, demand fell off on account of the high prices then ruling; and thirdly, exceptionally heavy rains and unseasonable weather during the warm season checked the usual summer requirements. It must also be borne in mind that the amount of Formosan sugar coming to Japan, on which there is no duty, is steadily increasing.

The market, based on Tokio sales, steadily receded from 18 yen 80 sen per picul in January to 16 yen 25 sen per picul in December.

Beet sugars, although still imported in fair quantity, are not coming in such large amounts as when Continental bounties existed. They are in demand for a particular kind of confectionery but they do not seriously affect the Japanese refineries. German beet sugar was selling at the close of the year at 15 yen 50 sen to 16 yen per picul.

The suggested amalgamation of the Osaka and Tokio refineries has for the present fallen through, and an alternative proposal to increase the capital of the former company has also met with considerable opposition, owing to the uncertainty which prevails as to the Government's intentions with regard to a sugar monopoly; meanwhile it is reported that a new refinery is being built at Kuwana.

During 1905 a determined attempt was made by the Japanese refineries to enter the Chinese market, and by keen undercutting of prices at Shanghai, considerable sales were made for delivery there in the early months of 1906.

GERMANY.

Dantzig.—The supply of sugar—raw and refined—imported from Russia receded considerably, amounting to 228,192 sacks (against 351,729 sacks in 1904 and 878,503 sacks in 1903).

The total export of sugar of all kinds from Dantzig, including raw sugar, was as follows:—

To	Quantity of Sacks of 220 lbs.
United Kingdom	628,530
Belgium and Netherlands	209,418
Denmark	48,021
Japan	13,956
Norway	72,879
Finland	202,297
Sweden	106,594
German States	282,308
	1,564,003

SWEDEN.

Gothenburg.—The 1905 sugar beet season has been specially favourable both to growers and sugar works. The beet crop yielded a high return, and the percentage of sugar likewise was high, varying between 15 and 17%. During the season now closed it was for the first time that the sugar mills paid for the beets according to percentage of sugar, and consequently the price of beets was somewhat higher than in previous years. The average yield of sugar beets during the year has shown about 17,000 kilos. per Swedish tunland (82 tunland being equal to 100 English acres), which is 30 to 35% above the previous year's yield. There were about 60,000 acres under cultivation for beets last year in the province of Scania.

TURKEY.

Baghdad.—During the early part of 1905 the price of sugar in the producing countries ruled high, but later in the year prices fell and a strong demand sprung up in Persia, when local prices rose to 4s. per maund of 17·70 lbs. Sugar from Baghdad is said to have gone as far as Teheran, which place, together with a considerable tract to the west of it, is usually supplied with Russian sugar. The supply comes roughly from France three-fifths, Belgium one-fifth, and Egypt one-fifth; a little also comes from Austria-Hugary.

Granulated and crystal sugar was imported almost entirely from Bombay.

CHINA.

Kiungchow.—Among the 1905 exports from Kiungchow sugar heads the list. Its value, £204,000, accounts for just over two-fifths of the total exports. The cane is grown extensively throughout the island. It is harvested and pressed in the fall of the year, and the sugar is kept over for export during the following season. The year 1904 yielded a full crop, as typhoons left the island unmolested. Climatic conditions having been favourable again during 1905, it is to be hoped that next year's returns will show similar results.

Ningpo.—In 1905 a very profitable business was done in refined sugar from Hong-Kong. The market opened firm and prices advanced 2 mace (about 6d.) per cwt. till September. From October to December prices fell 5 mace (about 1s. 2d.) per cwt., owing to the rumours of the competition of beet sugar. Large sales, however, continued to be made owing to the facilities as regards credit always accorded by dealers to up-country buyers at the end of the year.

Small quantities of Japanese refined sugar appeared on the market for the first time, but it is unlikely that it will ever seriously compete with the Hong-Kong product.

The trade in brown sugar shows an increase in volume, but the severe competition between Iloilo and Fokien resulted in low prices and a loss all round.

Imports for the last three years have been—

	1903 Lbs.	1904. Lbs.	1905. Lbs.
Sugar—			
Brown..	17,989,200	20,871,200	22,515,067
White	2,746,932	3,414,132	2,433,467
Refined..	20,863,332	19,514,267	20,597,067

ANGOLA.

The British Consul writes:—A prominent planter of sugar cane has expressed the opinion that, although the local refineries are fitted with modern and costly plant, the excessive taxes imposed on sugar render its manufacture unremunerative. The result has been an increase in the production of rum, which finds a ready sale in the province. Rum has for years past formed an important item in the barter trade with the natives, and its baneful influence on the native population has been animadverted upon in previous Consular reports on this district.

According to a Portuguese trade journal there are seven sugar factories in Angola, one of which is fitted out on the "Billion" system and cost over 1,000,000 fr. Each of these factories is capable of producing from "4000 to 5000 tons of sugar per month," but the journal draws attention to the fact that none of them completed their output in 1905, preferring to distil spirits instead. The reason for this preference being given to spirits is obvious since spirits command a greater price in the market. The journal estimates that the excise on spirits should bring in a revenue of £201,100 on a yearly consumption, which it fixes at 1,650,000 gallons. As, however, the journal contends, excise is rarely paid, it is easy to account for the manufacturers' choice of what must indeed be a remunerative business. The writer points out that taxation is levied on the producer, who apparently pays a nominal sum fixed by agreement, and not on the consumer, a method that would ensure a more efficacious control over the revenue. The article concludes by calling for remedial measures, and alludes to a revision of the African drink question by the Brussels Commission.

UNITED STATES.

New Orleans.—The importation of sugar is second only to coffee in importance. Together with molasses the value imported in 1905 amounted to £1,434,666, as against £1,916,251 in the year 1904. There was a large increase in the amount of beetroot sugar imported during the year under notice, £190,619 as against £12,143 that reached this port in 1904. Nearly all of the beetroot sugar is of German origin. The New Orleans refineries dealt with most of the Cuban output. It is only a question of time when the whole of the Cuban sugar crop will be received at this port and be distributed throughout the south and west.

REVIEWS.

THE SUGAR BEET: A SCIENTIFIC QUARTERLY, No. 1. Edited by Lewis S. Ware. Published at 608, Chestnut Street, Philadelphia, U.S.A. $5 per annum.

We have received the first number of the *Sugar Beet* in its new quarterly form, and must say that on the whole we are disappointed with it. What it does contain is good, as is only to be expected from a writer of Mr. Ware's experience. But when we are asked to pay 5s. for each number, we expect considerably more matter than is given us. Fifty-six pages, of a size very little larger than this journal, and printed in comparatively large type (to wit, *small pica*), does not amount to much, and we fear that unless succeeding numbers are better filled, the circulation will be too limited to pay. Again, the practice of editing the magazine in Paris and publishing it in Philadelphia, is not conducive to accurate reproduction, and the proof reading has left something to be desired. But apart from the above defects, this is a type of journal that might well find a permanent place in the libraries of beet sugar works, and we hope that its career may not be brought to a hurried termination from lack of support. There are some 25 short articles, including an excellent resumé of the Rome Congress of last May, and "Suggestions worth considering of interest to Sugar Factory Managers and Superintendents."

MONTHLY LIST OF PATENTS.

Communicated by Mr. W. P. THOMPSON, C.E., F.C.S., M.I.M.E., Chartered Patent Agent, 6, Lord Street, Liverpool; and 322, High Holborn, London.

ENGLISH.—APPLICATION.

19464. E. SHAW, London. *Improvements in or relating to the process of extracting sugar from cane stalks.* 31st August, 1906.

ABRIDGMENTS.

22709. Dr. A. CLAASSEN, Aix-la-Chappelle, Germany. *Process for facilitating the fermentation of sugar solutions obtained from wood that contains tannin.* 6th November. 1905. This invention relates to a process for facilitating the fermentation of sugar solutions obtained from wood or other cellulose substances containing tannin, the characteristic feature being the fact that the gallic acid set free from the tannic acid of the raw material is combined in the solution with iron, and that the combination thus obtained is precipitated by neutralising the solution by means of a carbonate, and adding hydrate of lime or other hydroxides of a similar character to it until it becomes slightly alkaline.

6009. T. DROST, Charlottenburg, near Berlin (Germany). *Improvements in mashing apparatus for promoting the crystallization of sugar masses, and for intimately mixing other pulpy masses with diluting agents.* 12th March, 1906. This invention relates to an improved mashing apparatus for promoting the crystallization of sugar masses, and for intimately mixing other pulpy masses with diluting agents, characterized by horizontal stirring arms, to which is imparted a positively rocking motion in addition to the rotary motion on the axis of the stirring shaft.

NOTE.—Copies of all published specifications with their drawings in these lists can be obtained from W. P. Thompson & Co., 6, Lord Street, Liverpool, at One Shilling a copy for English or American Patents, and Two Shillings for German. In ordering please give number and date.

Patentees of Inventions connected with the production, manufacture and refining of sugar will find *The International Sugar Journal* the best medium for their advertisements.

The International Sugar Journal has a wide circulation among planters and manufacturers in all sugar-producing countries, as well as among refiners, merchants, commission agents, and brokers, interested in the trade, at home and abroad.

IMPORTS AND EXPORTS OF SUGAR (UNITED KINGDOM

To end of August, 1905 and 1906.

IMPORTS.

Raw Sugars.	Quantities.		Values.	
	1905. Cwts.	1906. Cwts.	1905. £	1906. £
Germany	2,987,955	6,268,075	1,823,004	2,669,659
Holland	86,601	50,442	61,413	19,031
Belgium	298,667	516,913	218,321	217,964
France	220,806	203,201	146,418	87,539
Austria-Hungary	367,026	162,740	242,116	66,335
Java	1,891,956	223,264	1,301,387	104,766
Philippine Islands	9,680	....	4,840	....
Cuba	....	111,910	....	41,943
Peru	860,473	443,254	589,565	199,361
Brazil	77,900	959,855	42,765	375,649
Argentine Republic	....	....	....	....
Mauritius	158,460	127,205	87,369	48,362
British East Indies	256,634	88,267	143,662	34,351
Straits Settlements	156,858	55,930	83,943	22,959
Br. W. Indies, Guiana, &c.	873,126	1,435,423	710,971	760,738
Other Countries	668,807	183,794	464,038	85,108
Total Raw Sugars	8,914,949	10,830,273	5,919,812	4,733,765
Refined Sugars.				
Germany	6,879,389	8,578,711	5,548,267	4,872,784
Holland	964,111	1,913,782	820,194	1,148,404
Belgium	163,729	256,647	138,774	149,222
France	1,080,318	1,705,918	847,103	951,308
Other Countries	344,299	493	281,944	354
Total Refined Sugars	9,431,846	12,455,551	7,636,282	7,122,072
Molasses	1,584,652	1,802,576	319,142	347,137
Total Imports	19,931,447	25,088,400	13,875,236	12,203,004

EXPORTS.

British Refined Sugars.	Cwts.	Cwts.	£	£
Sweden	184	127	168	114
Norway	14,394	12,545	11,158	7,417
Denmark	57,170	73,640	41,821	37,061
Holland	51,861	51,545	40,870	31,012
Belgium	5,031	7,072	3,508	4,088
Portugal, Azores, &c.	9,987	19,037	7,477	10,365
Italy	2,643	26,002	1,817	13,215
Other Countries	192,090	439,593	173,880	283,948
	333,360	629,561	280,699	387,250
Foreign & Colonial Sugars				
Refined and Candy	14,474	28,298	13,326	17,429
Unrefined	53,748	148,633	39,529	75,727
Molasses	2,708	5,476	823	1,749
Total Exports	404,290	811,968	334,377	482,155

UNITED STATES.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1906. Tons.	1905. Tons.
Total Receipts Jan. 1st to Sept. 20th	1,498,641	1,400,096
Receipts of Refined ,, ,,	1,555	908
Deliveries ,, ,,	1,540,038	1,341,673
Consumption (4 Ports, Exports deducted) since January 1st	1,458,125	1,294,335
Importers' Stocks, September 19th	17,136	58,423
Total Stocks, September 26th	212,000	202,480
Stocks in Cuba, ,,	38,000	172,000
	1905.	1904.
Total Consumption for twelve months	2,632,216	2,767,162

CUBA.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1905 AND 1906.

(Tons of 2,240lbs.)	1905. Tons.	1906. Tons.
Exports	884,984	1,074,404
Stocks	212,777	69,836
	1,097,761	1,144,240
Local Consumption (eight months)	28,120	29,550
	1,125,881	1,173,790
Stock on 1st January (old crop)	——	19,450
Receipts at Ports up to August 31st	1,125,881	1,154,340

Havana, August 31st, 1906. J. GUMA.—F. MEJER.

UNITED KINGDOM.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION FOR EIGHT MONTHS ENDING AUGUST 31ST.

SUGAR.	IMPORTS. 1904. Tons.	IMPORTS. 1905. Tons.	IMPORTS. 1906. Tons.	EXPORTS (Foreign). 1904. Tons.	EXPORTS (Foreign). 1905. Tons.	EXPORTS (Foreign). 1906. Tons.
Refined	600,802	471,592	622,777	902	724	1,415
Raw	500,097	445,747	541,514	3,831	2,687	7,432
Molasses	55,957	79,232	90,129	83	135	274
Total	1,156,856	996,571	1,254,420	4,816	3,546	8,121

	HOME CONSUMPTION. 1904. Tons.	HOME CONSUMPTION. 1905. Tons.	HOME CONSUMPTION. 1906. Tons.
Refined	610,936	472,564	598,121
Refined (in Bond) in the United Kingdom	343,200	350,256	371,484
Raw	86,989	69,207	82,756
Molasses	53,269	74,609	84,783
Molasses, manufactured (in Bond) in U.K.	39,460	34,734	39,213
Total	1,133,854	1,001,370	1,176,357
Less Exports of British Refined	19,661	16,668	31,478
Total Home Consumption of Sugar	1,114,193	984,702	1,144,879

STOCKS OF SUGAR IN EUROPE AT UNEVEN DATES, SEPT. 1ST TO 22ND, COMPARED WITH PREVIOUS YEARS.

IN THOUSANDS OF TONS, TO THE NEAREST THOUSAND.

Great Britain.	Germany including Hamburg.	France.	Austria.	Holland and Belgium.	TOTAL 1906
161	308	417	178	75	1141

	1905.		1904.		1903.		1902.
Totals	773	..	1103	..	1488	..	1459

TWELVE MONTHS' CONSUMPTION OF SUGAR IN EUROPE FOR THREE YEARS, ENDING AUGUST 31ST, IN THOUSANDS OF TONS.

(Licht's Circular.)

Great Britain.	Germany.	France.	Austria-Hungary	Holland, Belgium, &c.	Total 1905-06.	Total 1904-05.	Total 1903-04.
1852	1135	660	531	198	4376	3731	4376

ESTIMATED CROP OF BEETROOT SUGAR ON THE CONTINENT OF EUROPE FOR THE CURRENT CAMPAIGN, COMPARED WITH THE ACTUAL CROP OF THE THREE PREVIOUS CAMPAIGNS.

(From Licht's Monthly Circular.)

	1905-1906.	1904-1905.	1903-1904.	1902-1903.
	Tons.	Tons.	Tons.	Tons.
Germany	2,415,000 ..	1,598,164 ..	1,927,681 ..	1,762,461
Austria	1,510,000 ..	889,373 ..	1,167,959 ..	1,057,692
France	1,090,000 ..	622,422 ..	804,308 ..	833,210
Russia	988,000 ..	953,626 ..	1,206,907 ..	1,256,311
Belgium	329,000 ..	176,466 ..	209,811 ..	224,090
Holland	207,000 ..	136,551 ..	123,551 ..	102,411
Other Countries .	415,000 ..	332,098 ..	441,116 ..	325,082
	6,954,000	4,708,758	5,881,333	5,561,257

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All Advertisements to be sent *direct*.

Cheques and Postal Orders to be made payable to Norman Rodger, Altrincham.

☞ The Editor is not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

NOTES AND COMMENTS.

The Brussels Convention.

Our announcement in last month's issue of the intentions of the Government with regard to the Brussels Convention has attracted some attention in Continental sugar papers. The *Journal des Fabricants*, after reproducing our note, asks if nothing can be done in virtue of the *entente cordiale* to persuade France's new ally to modify her economic views so that they may conform more to the mutual interests of the two countries. But our contemporary is strangely mistaken in thinking that Messrs. Yves Guyot and Joseph Caillaux have sufficient influence here to be able to avert the threatened calamity. To a Government of the present Radical type, their protests would be as "a voice crying in the wilderness." It may be remembered that the Cobden Club have remained stolidly unconvinced by all the arguments in favour of the Convention which their distinguished foreign member, M. Guyot, has placed before them. M. Guyot cannot therefore be expected to make any impression in official quarters. But supposing England's defection becomes a fact, there seems a general consensus of opinion abroad that the Convention should continue all the same. It is significant that the German sugar manufacturers, who were at first among the stoutest opponents of the Convention, are now decidedly convinced of its general utility, as the discussion at the annual meeting of the Raw Sugar Manufacturers held last May (for a description of which see another page) conclusively shows. Moreover, other countries have been hastening to join the Convention, *e.g.*, Denmark and Switzerland, so that it seems at present unlikely that England will find any State prepared to second her in the event of her deciding to denounce the Convention next autumn.

New Developments in Cuba.

The Cuban-American Sugar Company seems to have undergone reconstruction lately, as a new company of that name, with a capital of $12,000,000, is announced. It proposes to take over several existing sugar companies, including the Chaparra Sugar Company, the Tinguara Sugar Company at Perico, the Nueva Luisa Sugar Company at Jovellanos, and the Cardenas Sugar Refining Company at Cardenas. These companies produce an aggregate of about 110,000 tons of sugar, and own 230,000 acres of land. Another company lately projected—the Cuba Development Company—proposes to erect an immense sugar factory near Ceballos, in the Camaguey Province. Likewise the Silvesta Sugar Company is erecting in the same province a 3,580-ton factory, to be supplied by 7,000 acres of cane.

The Tongaat Sugar Company.

The Tongaat Sugar Company, Liverpool, seems to be doing well, to judge from a dividend of 16% which was lately announced at the annual meeting. But reference was made at the same meeting to the impending imposition of a shilling income tax in Natal, which would result in the company having to pay income tax both at home and in Natal. This would be an intolerable burden to them, and they would have to consider the advisability of removing the company to Natal. After all, this is evidently what Natal wants; as the business is carried on in that country, it seems only right that the taxes should be levied there. But as the Tongaat Company is registered in England, its profits are taxed at home too; and the directors may well grumble. The question for them to decide is whether the loss occasioned by giving up their home head-quarters will be more than balanced by the saving of half their income tax.

Mauritius.

From a correspondent we learn that the present crop is providing a series of surprises, very welcome to the planters in that island. Before the crop and during the first month of the same, prices ruled very low, and fears of a low average selling price were general. However, things have greatly improved, and if present prices remain steady no complaints will be heard. Besides, the returns, both in field and factory work, are extraordinarily good, and results formerly thought excellent have been totally eclipsed this year. The juice in canes is abundant, very pure, and easily worked. The crop will be a record one. All this one owes to the fact that, during the past season, no cyclone has visited the island. If this unwelcome visitor could only be kept away, this colony would come to the fore once more as a cheap sugar-producing country.

A Peruvian Experiment Station.

The Peruvian Government have recently started a sugar experiment station, and have retained Professor F. T. Sedgwick to organize and conduct it. As far as the funds will allow, it is being modelled after the Hawaii station of the H.S.P.A. Besides carrying on actual analytical work in the laboratory for the planters and for scientific research, and the establishment of field experiments, the plan is to work as far as possible directly with the planters by helping them in carrying on experiments on their particular estates. Thus a number of estates have already begun experiments in collaboration with the station. Some estates are also establishing chemical control. Moreover, a portable laboratory is being fitted out to take to those estates that are not equipped with laboratories, so that some work at least may be done for them. Doubtless when they have realized the advantages of chemical control for themselves they will start their own laboratories. It is evident that the leading sugar men are determined to better the conditions of their industry, as they have lately held meetings and appointed committees to look into the different departments of the work, such as milling, manufacture, fertilization, chemical control, etc., and we understand that they propose to submit their reports for discussion at a meeting to be held within a few months' time.

A Queensland Central Mill.

The last report of the Mulgrave Central Mill Co., Ltd., shows a net profit on the year's transactions of £2,793 10s., after allowing £207 10s. for depreciation. The price paid for cane was 20s. per ton for low land areas and 21s. per ton for high land, the total sum paid being £63,603. The average yield of cane per acre was 17½ tons. The number of Kanakas retained was 39, against 150 in 1904-5. This class of labour, however, gave a good deal of trouble, and the boys' conduct became so bad that every encouragement was given them to break their contracts and return to their islands. During the season of twenty-six weeks 62,746 tons of cane were crushed, and yielded 7,706 tons of sugar of 88 net titre. This gives 8·14 tons of cane to one ton of sugar.

Errata.

An unfortunate transposition of words led to an error in Mr. A. Watt's paper on the Estimation of Glucose in Beetroot Sugar appearing in our last number. Page 505, line 14 from bottom should read: "smallest amount, to 20% in the case of the largest."

Also on page 463 (September), line 2 from bottom and throughout the paper, "calcium chloride" should read "chloride of lime."

THE ECONOMIC ASPECT OF THE SUGAR QUESTION THIRTY YEARS AGO.

It is interesting, after thirty years of hard fight followed by a decisive victory, to come upon early views on the question; and eminently satisfactory to find in those views an accurate forecast of the future. We have accidentally discovered an old volume of the Transactions of that somewhat miscellaneous Society called the National Association for the promotion of Social Science—long since dead but then, in 1875, very much alive—and find it to contain the following brief paper on the political economy of Sugar Bounties. We reproduce it because it seems desirable to put on record the fact that, long before the days when the Board of Trade took the matter in hand and gave the Bounties a fresh lease of life, the danger of such an opposition was foreseen and its effects predicted. The Board of Trade, under the direction of its permanent Secretary, subsequently did a vast amount of mischief by helping the bounties to spread to other countries and to grow in size until they created an artificially stimulated industry which at one time monopolized more than two-thirds of the visible consumption of the world. The process was only beginning in 1875, Germany and Austria were still behind the scenes, the fight was merely with the French and Dutch sugar refiners, and the bounty was only on loaf sugar; but the author of the Paper saw that even that bounty injured our colonies, because every ton of foreign refined imported meant, in those days, a ton of raw cane sugar shut out. He also points to the possibility of the bounty being extended to other kinds of sugar. His economic argument accurately forecasts the line subsequently taken and even meets some of the present stock fallacies.

It is well to remember, in reading these lines, that the International Conferences of 1875-6-7 so completely exposed the folly of giving an enormous bounty to some half-dozen millionaires in Paris that the French Government, in spite of the failure of the attempt to secure an international agreement, took the matter in hand and before the year 1880 the great Paris bounty had dwindled to an insignificant figure. But in the meantime Germany and Austria had come on the scene and were rapidly becoming masters of the situation. The rest we know.

It will be seen that the writer condemns a policy of blind retaliation; but he did not forsee, what we now know from bitter experience, that a high protective duty can be converted into a bounty on export. This fact is the true basis for the present movement in favour of Tariff Reform.

PAPER READ BEFORE THE BRIGHTON MEETING OF THE SOCIAL SCIENCE ASSOCIATION, 1875.

Foreign Bounties on Export: should they be regarded and dealt with as beneficial or injurious to this country?

This paper has originated in the fact that a bounty is now paid in France on the export of loaf sugar, causing some disturbance to the sugar trade and recently attracting a certain amount of public attention.

The object is not to examine or explain technical details connected with this bounty, nor to dilate on recent negotiations between the British and French Governments on the subject. The aim is simply to gather together, and if possible arrange, various arguments advanced in the course of the public discussion of the question, which may afford suitable material for consideration in this section of a meeting devoted to questions of Social Science.

Trade is daily becoming more cosmopolitan, and international commercial questions are therefore constantly increasing in interest and importance. International competition is now so keen that any artificial disturbance to the course of trade is fraught with much more serious consequences than in former times, or than even as recently as ten years ago.

The policy of this country with reference to commercial questions has, on one point, become definitely fixed and beyond the reach of discussion. It is now practically admitted on all sides that British industry is to be in no way artifically fostered by State protection. The question which now arises is whether it is as universally conceded that the Government or Legislature of this country are not under any circumstances to resist an attack made on its commerce or manufactures by foreign State protection in the form of subsidies on exports.

To arrive at a satisfactory answer to this question it is necessary to determine whether the injury which an attack of such a kind must necessarily inflict on British manufactures and commerce is also a national injury; whether, apart from the trade disturbance, the British consumer is likely to be permanently benefited by obtaining a share of the foreign subsidy, or whether he will not be ultimately injured.

An endeavour will be made in this paper simply to put before the Section the considerations which have recently been urged on both sides of the question, leaving the points to be further argued if they should appear to offer matter of sufficient practical and scientific interest.

The arguments, or rather criticisms, of those who maintain that foreign bounties on export are beneficial to this country, have never been stated in any form of logical sequence, and are, therefore, somewhat difficult to arrange and define. These critics tell us that as foreign bounties tend to furnish us with the fruits of labour without labour—which we cannot do otherwise than open our mouths and take—it would be the height of folly to resist the temptation or look beyond the present moment. We should resign ourselves to the enjoyment of a present diminution in cost, and revel in the prospect of becoming an Epicurean nation, fed, clothed, and housed by the labours of our neighbours. Are we, they ask, to endeavour to make dearer articles of general consumption; to make laws against the consumer and against cheapness; to consider trades to be ends instead of means? Are we, in fact, to refuse commodities if they are offered to us for nothing? *

These are very telling criticisms, and the sources from which they come entitle them to careful consideration.

Those who take an opposite view had indeed previously anticipated and endeavoured to meet such reasoning. The following argument, extracted from a letter published before these criticisms appeared, is the best proof of this, and will also give a fair idea of the views of those who regard foreign bounties as an injury rather than a blessing to this country. The writers of the letter argue as follows:—"Many a free-trader, the correctness of whose principles we are quite ready to acknowledge, will very likely say that the public interest is benefited by unnaturally cheap sugar, and that therefore we and our colonial friends must go to the wall. We are ready to join issue with him on that point also, and to maintain that a temporary cheapening of sugar to the British consumer is not in this instance a public benefit, and for the following reason: The British consumer would, under natural conditions of supply and demand, procure his sugar as cheap as it could be supplied to him according to the ordinary laws of capital and labour, since he is free to get it where it can be produced and refined at the least cost. The Frenchman steps in and says: 'I will give it to you even cheaper than that.' The offer is, of course, accepted, and the other sources of supply begin to find that they are expected either to reduce their prices or to cease to compete with the Frenchman. This reduction of price will continue for a time, the Frenchman being artificially paid, in the shape of a bounty on exportation, to enable him to maintain it. But at last all the other producers will find that they can no longer continue the competition without loss, and they will therefore cease to produce. The Frenchman can still go on because he has a margin, beyond the turning-point between profit and loss, equivalent to the amount of his bounty. He will therefore be left master of the situation, and can dictate his own price to the British consumer, until the increased price has restored competition, when he will be able, as before, to repeat the process. The British consumer is, therefore, now enjoying an unnaturally low price for a time in order that he may in the end, and before very long, have to pay an unnaturally high price.

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* *Times*, March 26, 1875; *Daily News*, March 29, 1875.

"If anyone should say that the right policy is to wait till that time comes, we can only reply that that would appear to be almost as short-sighted a policy as to wait for any other kind of impending evil, or hostile attack, before providing the means for repelling it. We think that we have clearly shown that the system of bounties on exportation from France is as direct an attack on the market price of sugar in this country, with a view to raise it eventually by cutting down competition, as it is on the Colonial producer with a view to his final or temporary extinction. We rest our case, therefore, on the broad basis of the public interest, as represented by the consumer in the first instance, and then by the vast amount of British fixed capital devoted to producing sugar in our Colonies, conveying it to this country, and refining it here, where, as in the case of cotton and other goods, it can be made ready for the consumer at the least cost." *

That is the answer with which the disbelievers in the theory of an Epicurean nation, fed, clothed, and housed at the expense of its neighbours, had anticipated and attempted to meet it. It is for higher authorities to determine how far they have succeeded.

To show that their argument has already received very valuable confirmation, it may fairly be mentioned that it has been endorsed by the noble Lord who is now Minister for Foreign Affairs, and also by the noble President of this Association.† Lord Derby in fact repeated it in the following words when replying to the deputation of sugar refiners and West India planters and merchants, who were received by him and the Chancellor of the Exchequer last April. He then said:—"I quite agree especially with what was said by one gentleman who addressed us, as to the fact that cheapness was not in the long run likely to be promoted by this system of bounties, or that at the utmost a temporary artificial cheapness would be obtained, which might be followed by a permanent enhancement of the price." ‡

Again, in the House of Lords, in July last, Lord Derby said:— "Before I sit down I would just remark that I think my noble friend put this question a little too much as if it affected exclusively the interests of the colonial producer and sugar refiner. From one point of view it is also a question affecting the general interests of the public. We are convinced that any advantage of cheapness to the consumer which can be obtained by means of the bounty on foreign sugar will be temporary only; because, if the bounty were continued long enough and raised high enough to drive the English sugar refiner and colonial producer out of the market, then it follows that the foreign producer would get the monopoly of the market, in which case the price would not long remain at a low rate."§

Lord Aberdare said a few words at Bristol the other day which show that he fully concurs with this view. He is reported to have

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* Letter to *The Hour*, March 23, 1875.

† Lord Aberdare.

‡ Daily Papers, April 12, 1875.

§ *Times* Report, July 23, 1875.

said:—"Of course it was an advantage to this country to reap the benefits of cheaper productions in other countries, but the effect of these large bonuses to French manufacturers was this, that they were rapidly destroying the refining industry in this country. There were large manufactories already closed. If this continued they would find that the present refiners of sugar would cease to exist, and the British consumer would find that instead of a decrease there would be an increase in the price of sugar. It was therefore of interest to the British consumer that these absurd and extravagant bonuses on French sugar should cease."*

Other authorities for this view may be found† even among those who in the first instance propounded the Epicurean theory, but they qualify their admission by expressing a doubt whether the facts of the case do not show that the danger is rather hypothetical than real and imminent.

To reply to this it is necessary to leave for a moment the domain of abstract argument. The real facts of the case are these. The French refiners at present export and receive a bounty on loaf sugar only. The number of loaf sugar refiners in this country has, through the effects of this bounty, gradually dwindled down from between twenty and thirty to four. Only two out of these four have continued to make the finer kinds of loaf sugar with which the French bounty-fed sugar more especially competes. They have hitherto continued working and held their own in spite of this subsidised foreign competition. The recent increase in the bounty has, however, so stimulated the French exports that these refineries have now been obliged to close their works. The hypothetical danger has therefore now become an accomplished fact. The bounty-fed export of loaf sugar from France *has* already practically destroyed the home competition; and the French refiners, having succeeded thus far, will now no doubt turn their attention to securing the monopoly in other kinds of sugar.

Those who began by saying that foreign bounties tend in the direction of getting the fruits of labour without labour, and that such a change in our position must be a blessing, have ended by joining higher authorities in admitting, and have even claimed to have discovered, a hypothetical possibility that the reverse may be the case. They have endeavoured to spoil the value of their discovery by trying to infer that the hypothesis was practically impossible; but the facts of the case require them to admit that it has become a reality, and that though their ideal of an Epicurean nation, fed with loaf sugar by the labours of our neighbours, may come to pass, it will be coupled with the unexpected but very natural condition that our neighbours should dictate the price to be paid.

The Epicurean theory being left in this position, there comes the further question,—How far any effort to avert what is now admitted by high authority to be a national, as well as a trade injury, would be consistent or at variance with the established policy of this country? The ultimate injury inflicted by the foreign bounty is now allowed to be two-fold. It removes production and manufacture from the positions in which natural advantages would permit them to be carried on at the least cost, and by that means creates an artificial monopoly which raises the price to the consumer. If a remedy can be found which would simply prevent such a result, can it be condemned as contrary to free trade doctrine?

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* Bristol newspaper report, August 28, 1875. † *Times*, April 12, 1875.

In entering upon this consideration it is important to realise the difference between a protective duty on imports and a protective bounty on exports, because the two appear to have been sometimes confused in discussing the policy which should be adopted with respect to the latter. It has, therefore, been pointed out that while a duty on imports, levied with the view of protecting a home industry, affects other countries only by shutting out their products from that particular country, and restricts only so far their industries, a bounty on export is a protection of an aggressive character, since it does not, as in the former case, merely amount to saying, "you shall not send your goods to our country," but goes further and adds, "you shall not send your produce anywhere, nor shall you consume it yourselves; you must cease to produce and must take our produce instead."

Political economists have demonstrated that in the former case, that of foreign protective import duties, it would be unwise for this country to adopt a retaliatory policy and say, "Because you will not admit our produce we will not admit yours," since that would be injuring this country by shutting out from it those commodities which are produced more cheaply elsewhere, merely because foreign countries were so foolish as to do the same.

But, it is argued, the second case—that of aggressive protection by means of bounties on export—is of so different a character that it does not admit of having the same reasoning applied to it. Those who do so are in fact confusing two distinct questions. It is urged that the aggressive policy of export bounties is not confined to self-injury, but is a direct attack on the industries indigenous to neighbouring countries; is not merely a foolish refusal, on the part of the country which practises it, to buy in the cheapest market, but an attempt—which in the case before us has succeeded—to prevent the production of commodities where they can be produced at the least cost, in order to secure a monopoly which must eventually raise their normal price. If free-trade means liberty to buy in the cheapest market, that definition, it is argued, must be interpreted in its fullest sense and be held to mean liberty to buy in the market where goods are produced at the smallest cost, since that is the only market which can be permanently the cheapest. Free-trade is only partially limited if another country, by imposing a protective duty, refuses to buy the commodities which we produce most cheaply, but it is entirely checked if another country, by giving a bounty on export, prevents us both from producing and procuring commodities where they are naturally produced at the least cost. In the first case the protection only acts as a disadvantage to the country which adopts it and to the particular trade affected, but in the second the injury becomes general. A bait is held out, appearing at first to be simply a tribute presented to consumers in other countries, but really meant to force trade out of its natural channel, and establish a monopoly which will more than repay the original outlay and thus impose a burthen instead of a blessing on those who accepted it.

The difficulty is to evade the snare; it being useless to tell consumers not to buy below cost price, or warn them against the inevitable consequence. Instead of refusing the apparent tribute it has therefore been proposed to accept it in such a way as to neutralize its injurious effect. In the case of a foreign protective duty, a similar duty levied by us would be mere blind retaliation, because it would merely injure both our neighbour and ourselves. Such a retaliatory duty would be inconsistent with free trade, and therefore at variance with the established commercial policy of the country. But, in the case of a foreign export bounty, it is contended that a home import duty on the commodity, equivalent to the bounty it receives, would simply transfer the receipt of the tribute from the consumer to the revenue—thus giving the nation the benefit of it in another form—and might prove to be the only means of neutralizing its effect, by maintaining the existence of the naturally and therefore permanently cheapest market. Such a course, it is admitted, would deprive the consumer of the deceptive pleasure of enjoying for a time a commodity at less than its natural free trade price, but it would secure to him the continuance of its supply at that price, and thus save him from falling into the hands of the monopoly which is now admitted to be otherwise inevitable. A duty of that character cannot in any sense be called retaliatory, since its sole object would be to retain the power of buying in the permanently cheapest market, by maintaining production where it can be carried on at the lowest cost. Its object would rather justify the appellation of a free trade duty.

The question then comes to this: If this should ultimately be found to be the only remedy, and if this country should refuse to adopt it, could that refusal be justified on the ground that our commercial policy is regulated by the principles of free trade?

These arguments have been advanced by those who, while laying no claim to speak with authority on economical subjects, have been driven by the grievous results of an actual case in point to probe the difficulty to the bottom and seek for a remedy. The question is, therefore, one of much greater interest, and deserves more serious consideration than if it were purely hypothetical. For these reasons it is thought to be one well adapted for examination in the trade section of a scientific meeting like the present.

On this occasion the question of principle is alone raised, because it is important to have that granted before going into the mode of application. To confuse the two would, perhaps, be to obscure a clear view of either, and might lead to an avoidance of the important and interesting problem which is involved. It would not be right or fair to evade the admission of the principle by falling back on a question of practicability. If the principle be once admitted it will be for those who now advocate it to show how it can be put into practice.

In this paper care has been taken to omit from the estimate of the national injury inflicted, the item of loss to the natural productive, trading and manufacturing capabilities of this country and her colonies. That is a separate element in the question, opening up a different line of argument, to enter into which time does not now permit.

In dealing with the subject of this paper the writer has not presumed to speak with any authority, or to claim any originality, but has confined himself to collecting and recapitulating arguments recently advanced on various sides and published in a scattered form, and offering them for the consideration of this department.

CONTROL ON THE MILL WORK.

It is a well-known fact that the extraction, the sucrose extracted on 100 sucrose in the cane or the moisture in the megass are each one alone no good record of the work done by the mills. With a low moisture content in the megass its sucrose content can be comparatively too high when the maceration is applied in the wrong place or not in sufficient quantity.

A figure which combines all the factors that influence the millwork is:

"First mill juice lost on 100 fibre,"

formula:

$$\frac{\text{Sucr. megass}}{\text{Fibre megass}} \times \frac{10000}{\text{Sucr. 1st mill juice}}.$$

Here the sucrose content of the first mill juice neutralizes the sucrose content of the megass while the "percentage" of fibre in the cane is neutralized by calculating on 100 fibre. With this figure it is possible to compare directly the work of all kind of mills, also of the Naudet process.

With triple crushing it should be under 60, while it can be as low as 45. The Naudet process will reduce it to 20 to 25, while on the muscovado estates it ranges from 300-120.

J. Lely.

Antigua, September 10th, 1906.

Mr. NURSEY ON CANE SUGAR MACHINERY.

On October 1st a paper was read by Mr. P. F. Nursey, at a meeting of the Society of Engineers, on "Recent Practice in Cane Sugar Machinery,"* the author's object being to indicate the general trend of improvements effected in sugar machinery since his former paper on the same subject just 41 years ago.

To engineers not directly connected with the sugar industry the paper must have proved exceedingly interesting and instructive, but progress has been so rapid that many of the appliances referred to have long been familiar to the sugar expert. On this account we have refrained from reproducing the paper in full; but will here endeavour to treat the subject from the sugar maker's point of view.

Mr. Nursey's paper was compiled from information received by him from manufacturing engineers, who make a speciality of sugar machinery. Each firm, in turn, exhibited its wares; a proceeding which involved much repetition and rather suggested free advertisement. We may add that the exhibition was unfortunately limited to *British* firms.

The author, admitting the impossibility of doing justice to his subject in the limits of a single paper, selected those features of the subject which would be of interest to engineers generally, with the result that crushing machinery occupied the most prominent position. The most striking development had, of course, been in the direction of multiple crushing, and this was copiously illustrated by recent milling plants emanating from well-known firms. The modern mill, with its nine or even eleven rollers, is, no doubt, a fine example of engineering skill, but as a means to a practical end, there is still room for improvement, if only in the direction of simplifications and cost. The *principle* of this method of extraction being admittedly defective, all radical improvements have taken the form of supplementary appliances or operations. This fact was not sufficiently emphasized in the paper under review, with the result that what may be called improvements in the extraction of the juice were hopelessly entangled with improvements in the construction of the machinery. Improvements of the former class are of vital interest to the *users* of machinery, whilst those of the latter class are mainly of interest to the *manufacturers* of the machinery. As an example of this, the subject of maceration during milling was very inadequately treated, presumably because it embodied no striking mechanical features but merely a "sprinkler" or an "immersion bath." Yet the modern mill owes much of its efficiency to this simple contrivance, which, by the way, was borrowed from the beet sugar factory. Another example was furnished by the scanty reference to the "crusher" type of mill, the Krajewski model being the only example referred to, if we exclude the Bekker mill, which is really a combination of crusher and mill.

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* On another page a summary of this lecture will be found.

The opinions of manufacturers appear to differ considerably as to the relative merits of the Toggle Gear and hydraulic attachment for relieving the mill from sudden strain. Judging from the numbers of factories where the Toggle has been replaced by the hydraulic apparatus, the latter would appear to have gained general favour, at any rate in the West Indies. The use of oil instead of water for transmitting the pressure is recommended by one firm to prevent rusting.

Of other accessories to the mill mention was made of the pusher feed gear, the value of which has long been appreciated as a labour-saving invention, but which is capable of much improvement.

A serious defect in multiple crushing plants is the usual form of intermediate carrier, which seems specially designed to break up the blanket of megass issuing from the first mill and thus necessitate hand or automatic feeding of the second (or third) mill. As the Krajewski, or other type of crusher, prepares the feed to the cane mill, so each mill should prepare the feed for the one behind it; the blanket of megass retaining its cohesion whilst being reduced in thickness or depth by each successive milling. Only one firm appears to have attempted to solve this difficulty by employing an intermediate carrier of special design, of which a more detailed description would have been of interest.

Passing from the subject of cane mills the author turned to centrifugal machines, although a better plan would have been to introduce the Naudet process at this stage, as being either a supplementary method of extraction, or a particular example of maceration. It is to be regretted that the author had not grasped the intricacies of this process so as to be in a position to judge of its merits, but he contented himself with a description of the apparatus furnished by the manufacturers. Had this been limited to an outline of the battery operation it would, we think, have been more intelligible than any attempt to describe the apparatus itself. A brief account might have been added of the improvements affected since the process was first applied to the cane sugar industry by Mr. Hinton, and even an indication of the direction in which further improvement seems desirable would not have been prejudicial. Those who expected to hear the new process discussed during the evening were disappointed. Mr. Llewelyn Jones merely questioned the accuracy of the published figures representing the results obtained by the process in Trinidad, and Mr. Alliott pointed out that to extract all the sugar from the megass does not necessarily mean a corresponding increase in marketable sugars. In view of these criticisms it is highly desirable that more complete data should be forthcoming, and signed by two or more impartial authorities.

Under the heading of "Defecation," reference was made to the modern tendency to employ high-pressure steam and to increase the velocity of the flow of juice through the heaters. The Deming Process was not, however, mentioned. Another improvement is described as follows:—"The juice, after leaving the high-pressure heaters, passes to a large receiver where it is kept hot and agitated. From this receiver the juice, with all its impurities, is passed through filter-pressers, first at a low pressure, then at a medium pressure, and finally at a high pressure, the result being an absolutely clear juice, free from all suspended matter, which can, without any further treatment, be taken into the multiple effet evaporator." From this description we are led to conclude that the entire output of juice has to be filtered three times over. It is well that "further treatment" is unnecessary. Under this head a brief reference should have been made to the system of "closed clarification," adopted in the Naudet battery.

Under evaporating plant, descriptions were given of multiple effet evaporators and vacuum pans by different makers, the only recent improvement being the Meyer and Arbuckle Film Evaporator, described in the following words: "The apparatus consists of a revolving arm, which sprinkles the juice or liquor over the heating surface in each evaporating vessel, a pump being attached for delivering and circulating the liquor." This appliance possesses the obvious advantage that it can be "adapted to existing evaporators."

On the subject of centrifugal machines, the paper referred to the improved methods of belt-driving, water-driving, and electro-driving; all of which are sufficiently familiar to the readers of this Journal. The Patterson's Syrup Classifying Apparatus is an ingenious modification by which the true molasses are completely separated from the subsequent washings of each charge. These washings "may then be returned to the vacuum pan to produce the same grade of sugar, instead of passing away with the molasses into a lower grade." It is claimed that the apparatus increases the yield of the higher grade sugars by from 5 to 10%.

In reply to a question put by Mr. Llewelyn Jones, the author was obliged to explain that although he appealed to two well-known firms who make a speciality of centrifugal machinery, only one of these supplied him with the information required; the other apparently not desiring to be mentioned in connection with a competitor. This single instance of seeming jealousy between representative firms is to be regretted, and might have been avoided had the author of the paper confined his remarks to sugar machinery, and omitted the manufacturers' names.

The Russian sugar refiners have, it is stated, resolved to abolish the agreement regarding the regulation of production.

ELECTRO-DECOLORIZATION.

A Study in Optical Sugar Analysis.

By F. G. WIECHMANN, Ph.D.

The Problem.—Saccharimeters are designed to return a reading of 100 degrees Ventzke, representing 100% of sucrose when the chosen normal weight of chemically pure sucrose is dissolved in the chosen volume of water.

The ideal clarifying reagent would be one which would remove from a normal aqueous solution of raw sugar everything except the sucrose and the water, and which in so doing would cause no change whatever in the original optical rotatory power of the sucrose.

It is well known and generally admitted that the basic acetate of lead solution, as at present used with the sanction of the International Commission for Uniform Methods of Sugar Analysis, is not above criticism.

In the first place, the use of this reagent causes an error by its mere presence: the precipitate it forms in clarifying the sugar solution occupies a part of the space which should be taken up by the solution, and, in consequence, that solution is unavoidably concentrated.

In the second place, this reagent forms chemical combinations with at least some of the optically active bodies, which are frequently present in raw sugars, without, however, necessarily removing such bodies from the solution. It is a well known fact that such chemical combinations formed by this reagent with these optically active bodies, sugars and non-sugars, possess optical properties different from those originally exhibited by the bodies, and that it is therefore practically impossible to make a proper allowance for their optical influence.

Seeking for a method by which the difficulties indicated might be at least partially avoided or overcome, attention naturally turned to electrical energy as the agent capable of bringing about chemical changes without necessarily introducing material reagents into the solution under examination. Making this consideration the point of departure, several series of experiments were planned to determine what degree of decolorization might be secured in sugar solutions by passing electric currents through them respectively from insoluble and from soluble electrodes.

By insoluble electrodes are of course understood electrodes which do not send ions into the solution: by soluble electrodes, such as do.

Four experimental series were thus planned:—

Series A.—Electrodes, platinum; solvent, water.

Series B.—Electrodes, platinum; solvent, water and hydrogen peroxide solution.

Series C.—Electrodes, lead; solvent, water.

Series D.—Electrodes: anode, lead peroxide; cathode, lead; solvent, water.

In all instances the work was done on *normal* sugar solutions, that is to say, on sugar solutions made up to the proper degree of concentration *before* decolorization; in each of these methods therefore the precipitate error is entirely obviated.

Source of current.—The electrical energy used in these experiments was secured either from a motor generator, or from the direct lighting current available in the laboratory.

The motor generator was a low voltage (electrolytic) generator with a range of from three to fifteen volts, run by a motor on a 110-volt direct current.

When the lighting current was used directly, the current-density was regulated by means of a bank of electric lamps, made by arranging a number of lamp sockets partly in parallel, partly in series, upon a slab of slate, and inserting the necessary number of lamps properly grouped to give the desired result.

When lamps are arranged in parallel their combined resistance is equal to the resistance of one lamp multiplied by the number of lamps in parallel; when arranged in series, their combined resistance is equal to the resistance of one lamp divided by the number of lamps in series.

Assuming, for instance, that eight sixteen-candle power lamps are available, and that the bank of lamps is arranged in such a manner that these can be used either in parallel or in series, that the electromotive force equals one hundred and ten volts, and the resistance two hundred and twenty ohms, then the eight lamps, if arranged in parallel, would allow $\frac{110}{220} \times 8 = 4$ amperes to pass through. On the other hand, if they were arranged in series then only $\frac{110}{220 \times 8} =$ 0·062 ampere would pass.

It is thus evident, that by the grouping of the lamps, some in parallel and some in series, and, moreover, by using lamps of different resistances, almost any desired amperage may be obtained.

The resistance of an electrolyte varies with its chemical composition, its concentration, and its temperature. An increase in temperature decreases the resistance of an electrolyte, and in this respect, therefore, an electrolyte resembles carbon.

Current Measurement was effected by means of a Weston voltmeter and a Weston milli-voltmeter used as an ampere-meter.

The voltage was measured directly across the electrodes, the ammeter was inserted in the main circuit.

Electrodes.—As previously stated, both insoluble and soluble electrodes were used in the experiments.

Carbon and platinum were tried as representative of the first group aluminium, lead, and lead peroxide were used in the tests with soluble electrodes.

Various forms of electrodes were experimented with: foils, flags, annular rings and bands, open and closed cylinders, wave-plates, and wires.

In some experiments both electrodes were stationary; in others, one of the electrodes was kept in motion. In short, a great many preliminary experiments were made in order to ascertain the normal current-density, *i.e.*, the current strength for 100 cm.^{2} of electrode surface, best suited for the work to be done.

This concept of a normal current density is symbolized by the expression:

$$N\,D_{100} =$$

Thus, for instance—

$N\,D_{100} = 0{\cdot}25$ signifies that 0·25 ampere is passing per 100 square centimetres of electrode-surface.

At first a number of tests were carried out in which both electrodes were placed in one compartment; later, it was determined to be distinctly preferable to work with the two electrodes in separate compartments. This naturally brought the problem of septa up for consideration.

Septa.—A number of experiments were made with septa of clay and of porous earthenware, but finally parchment was selected as best adapted to the needs of the situation.

Experience taught that considerable caution had to be exercised in the selection of the parchment for the purpose. Some of the parchment experimented with diffused an optically active copper-reducing body into the solution examined and this of course vitiated the experiment.

That such was the case was established by the following tests in which the solutions of a high grade granulated sugar were prepared and in which platinum electrodes were used.

I. The polarization before passing the electric current .. 99·61

II. Polarization after passing the electric current ($N\,D_{100} = 0{\cdot}055$) with a parchment septum between the anode and the cathode chambers:—

Polarization of anode solution .. .. 100·38
Polarization of cathode solution .. .... 100·33

III. Polarization after passing the electric current for five minutes ($N\,D_{100} = 0{\cdot}020$), without any parchment or other septum in the solution.

Polarization of solution .. .. 99·58

An examination of the copper-reducing power of these solutions gave respectively:—

I. Original solution before the passing of the electric current:—

Reducing sugar .. .. 0·12 per cent.

II. After passing of the electric current—parchment septum present:—

	Reducing Sugar. Per cent.
Anode solution	0·55
Cathode solution	0·50
Anode and Cathode solutions mingled	0·53

III. Solution after passing the electric current but without parchment septum . . . . 0·14 per cent.

Those results were further verified by experiments in which all of the above described conditions were duplicated, except that in place of a sugar solution, pure distilled water was used, a parchment septum of course dividing the electrolyte cell into anode and cathode chambers.

After passing an electric current for five minutes $(N D_{100} = 0{\cdot}10)$, the distilled water, originally optically inactive, showed a polarization of:—

Anode solution	+ 0.80
Cathode solution	+ 0·75

20 cc. of these anode and cathode solutions, mixed, reduced 0·057 gram of copper from Fehling's solution.

20 cc. of this aqueous solution were then evaporated in a water-bath and were dried in an air-bath for an hour at 100° C., and a pale yellow gummy residue was obtained. This weighed 0·0392 gram equivalent to 0·196% of the weight of the solution evaporated. This substance was found to be neutral to phenolphthalein and to litmus; it was not sweet to the taste. Its solution is dextrorotatory, it reduces copper from Fehling's solution and gives an amorphous yellow-white precipitate with absolute ethyl alcohol. On ignition, the 0·0392 gram of substance left 0·0001 gram of ash.

Possibly this substance is identical with the "fulminose" described by Blondeau de Carolles,* and which he isolated from parchment-paper.

It was soon learned that all of this parchment-sugar can be entirely removed by repeated boiling with distilled water, and all of the experiments to be described hereafter were made with parchment thus treated and subsequently dried and ironed to perfect smoothness. Each batch of parchment so prepared for experimental work was of course submitted to preliminary examination, both optical and with Fehling's solution, to ensure the removal of every trace of the parchment-sugar.

Electro-cells.—After considerable experimenting to find the most suitable, simple, and effective form of apparatus in which to effect the decolorization, two forms of cell were adopted; both seem to answer the purpose well.

One—cylindrical in form—consists of a cell-frame of hard rubber, designed to support a cylinder of parchment. This cell is placed within a cell or beaker of glass. The one electrode, a cylinder with closed ends, is placed within the parchment cell; the other electrode, an annular band, is fitted tightly against the wall of the glass cell. The whole apparatus can be enclosed in a water jacket through which a current of water can be kept coursing during the experiment, should an absolutely uniform temperature of the cell-contents be maintained.

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* Ann. Ch. Phys. (3) LXVIII., 462; Liebig and Kopp's Jahresb. der Chemie 1863, p. 567 Tollens, Handbuch der Kohlenhydrate, Vol. I., p. 229.

The rubber cell-frame consists of five pieces.

(*a*) A circular piece provided with three equidistant prongs.
(*b*) A circular centreplate supplied with shoulder.
(*c*) A spring-ring with three notches for the insertion of the prongs.
(*d*) A top ring with three equidistant prongs.
(*e*) A circular top cap provided with three notches to catch the prongs of piece “*a*.”

In putting together the apparatus, a strip of parchment 165 mm long, and 55 mm. wide is inserted, the ends overlapping, inside of the prongs of piece “*a*.” Care is taken that the overlap is placed in front of one of the prongs.

Thereupon piece “*b*” is placed inside of this parchment cylinder, and then piece “*c*” is inserted so as to lock rim of the shoulder of piece “*b*.”

Then piece “*d*” is introduced; its prongs are placed inside of the parchment, and fitted into the notches of piece “*c*.” Finally, piece “*e*” is placed as a cap on the rest, its notches catching the prongs of piece “*a*.”

The parchment is thus firmly held between the two sets of prongs.

The cylinder-electrode is now placed within the parchment cell, the other electrode having previously been fitted tightly against the wall of the glass cell, the whole apparatus is ready to be placed in the water jacket.

The dimensions employed in the apparatus specially made for these experiments are as follows:—

Piece “A.”	mm.
Base, external diameter	51
Base, internal diameter	47
Height from rim	12
Height of prongs	43
Width of prongs	5

Piece “B.”	
Diameter, base	38
Diameter, top	35
Total height	10
Height to shoulder	8

Piece “C.”	
External diameter	46
Internal diameter	39
Total height	10
Height to shoulder	8
Notches, width	5
Notches, depth	5

Piece “D.”	
External diameter	46
Internal diameter	44
Prongs, length	45
Prongs, width	5

Piece “E.”	
External diameter	56
Internal diameter	48
Internal diameter, top	40
Height of shoulder	7
Notches, depth	7
Notches, width	5

In one series of experiments, the dimensions of the electrodes were:—

Cylinder—closed at both ends:
Height .. .. 35 mm.
Diameter .. .. 35 ,,
Annular Band:
Height .. .. 23 mm.
Diameter .. .. 60 ,,

The distance between each electrode and the parchment was 5 mm. A platinum wire from each electrode was connected with the copper leads which supplied the current. Experiments were made with this circular cell in which the $N\,D_{100}$ values ranged from 1·11 to 4·92.

The square cell is also made of hard rubber. It consists of two plates, each 125 mm. square, and rimmed on three sides with raised edges 12 mm. thick. The receiving chambers which have been hollowed out of the rubber-plates to a depth of 5 mm. are 100 mm. × 110 mm. and are each provided at the base with a discharge-opening.

To use the apparatus the parchment septum is placed between these two rubber plates, these are tightly locked together by four metal pegs placed at the corners, and the whole is then firmly clamped in a wooden frame; after the two electrodes have been slipped into place on either side of the parchment, the apparatus is all ready for use.

The distance from each electrode to the septum is 5 mm. The electrodes have each an active surface of 100 $cm.^2$ *i.e.* = 1 $dm.^2$ and the amperes employed therefore at once express normal current-density values.

Optical Determinations.—All of the polarimetric observations were made by means of a double-wedge compensation saccharimeter, built by J. Peters, of Berlin, examined and certified to as correct by Prof. Dr. Herzfeld, of the Institute of Sugar Industry at Berlin.

The correct adjustment of this instrument was controlled before each experiment by means of a standard quartz plate and by observations of the zero point. Furthermore, the observation-tube which was used in each instance was examined as to any possible optical activity of its cover glasses before being filled with the solution to be examined. The light was in every instance obtained from a 50 candle-power, 110 volt, spiral-shaped filament, and the light so obtained was passed through three centimeters of a 6% solution of potassium-dichromate; the temperature of the saccharimeter was kept as close to 20° C. as possible. Naturally, only carefully standardized metric flasks and weights were used. The solution in each case was made up by dissolving 26 grams of the sugar to a volume of 100 metric cc.

Tintometer Observations.—The amount of decolorization secured was determined by means of a Lovibond tintometer; a description of

Lovibond's method will be found in the *Journal of the Society of Chemical Industry*, Vol. XIII., April 30, 1894.

The method adopted to determine the amount of colour removed consisted in matching the colour of both the original solution and of the treated solution against the Lovibond glasses, subtracting the value of the latter from the former and calculating what percentage the difference obtained was of the original colour.

Example:—

Original solution required glass..	57
Treated solution required glass	2

57 less 2 = 55; 55 is 96·49% of 57; hence, 96·49% of the original colour was removed.

The method adopted.—Concerning the manner of carrying on the experimental determinations, this was in all instances the same, briefly, as follows:—

Twenty-six grams of the sample to be experimented upon were dissolved up to 100 metric cubic centimeters. The electro-cell having been prepared as previously described, 75 cc. of the sugar solution were poured into the same, this amount being evenly divided between the anode and the cathode chamber. The electric current was turned on and passed for a given length of time—with a few exceptions—for a period of five minutes. Observations of voltage and amperage were taken every 30 or 60 seconds. The temperature of the solution in both anode and cathode chambers was carefully ascertained before turning on the electric current and again immediately after. After the passing of the current the solutions were immediately drained from their respective chambers and filtered through double layers of S. & S. filters, both the filters and the receiving vessels being kept carefully covered throughout to prevent concentration by evaporation as far as possible.

As soon as a sufficient amount of a solution had been filtered, the same was placed into an observation tube, 100 or 200 mm. long, as the case might warrant, and observation of the same made in the saccharimeter.

Reference has already been made to the fact that the correct adjustment of the saccharimeter was carefully determined by at least two competent observers before each experiment. In the same manner all readings on all solutions were made by at least two observers, each one of whom took four readings; the first of these was in all cases discarded, and the value ultimately accepted as the polarization value of the solution examined is therefore the average of six observations by two observers.

In a number of experiments three observers took part in the work, and in these cases, of course, the values found represent the average of their determinations.

Here I should like to express my thanks and obligations to my two assistants, Messrs. J. E. Kelley and T. Dom, for their valued aid in these experiments.

As an illustration of the manner in which the experimental work was done, the following record of a single experiment is given:—

Number of solutions prepared = two, *A* and *B*.
Sugar used: 1st Beet sugar.
Solvent used: Water.
26·0 grams up to 100 metric cc.

Solution A: clarified with 2 cc. basic lead acetate solution, Int. Com. Standard.

Room temperature = 20° C.
Solution temperature = 20° C.
Saccharimeter temperature = 20° C.
Saccharimeter in adjustment at zero point and at 98·6°.

Polarization-readings in 200 mm. tube:—

Observers:	*A.*		*B.*
	94·7	....	94·8
	94·7	....	94·7
	94·7	....	94·6
	294·1	....	294·1
	94·7	....	94·7

Average polarization = 94·70.

Solution B.—no preliminary clarification; solution placed in electro-cell, current passed for five minutes.

Electrodes:—

Anode = lead 10 × 10 cm.
Cathode = lead 10 × 10 cm.
Distance between electrode and parchment, in each chamber = 5 mm.

Electric data:—

	Ampere.		Volts.
Start	0·25	....	4·0
After 30 seconds	0·26	....	4·0
,, 60 ,, ...	0·27	....	4·3
,, 90 ,, ...	0·26	....	4·2
,, 120 ,, ...	0·24	....	4·2
,, 150 ,, ...	0·24	....	4·6
,, 180 ,, ...	0·23	....	4·75
,, 210 ,, ...	0·21	....	4·65
,, 240 ,, ...	0·20	....	4·75
,, 270 ,, ...	0·20	....	4·75
,, 300 ,, ...	0·20	....	4·80
Average ND_{100} =	0·23		4·45

Temperature data :—

Original solution, before passing electric current	20·0° C.
Anode solution, after passing electric current	20·0° C.
Cathode solution, after passing electric current ..	20·0° C.

Reaction :—

Original solution	Acid to litmus.
Anode solution	Acid to litmus.
Cathode solution	Alkaline to litmus. Alkaline to phenol-phthalein.

Decolorization :—

			Per cent. of Colour removed.
Original solution	=	Glass 24	
Anode solution	=	,, 3	87·50
Cathode solution	=	,, 18	25·00

Polarization readings of anode-solution in 200 mm. tube.
Saccharimeter in adjustment at zero and at 98·6°.
200 mm. tube, empty, optically inactive.
Room temperature, 20·0° C.
Solution temperature, 20·0° C.
Saccharimeter temperature, 20·0° C.

Observers :	*A.*	*B.*
	94·60	94·80
	94·90	94·85
	94·80	94·80
	284·30	284·45
	94·77	94·82

Average polarization = 189·59 ÷ 2 = 94·79.

Polarization of solution, clarified with basic acetate of lead	94·70
Polarization of anode solution after electric treatment	94·79
Difference =	0·09

Experimental Data.—As previously stated, four experimental series were carried on: A, B, C and D :—

In *A.*—Electrodes = platinum.
Solvent = water.
In *B.*—Electrodes = platinum.
Solvent = water and hydrogen peroxide solution.
In *C.*—Electrodes = lead.
Solvent = water.
In *D.*—Electrodes = anode, lead peroxide; cathode, lead.
Solvent = water.

In every experiment normal weight sugar solutions were used. The electric current was passed for five minutes, and the observations were made and recorded as previously indicated.

Series A.—In this series the contents of the anode compartment experienced a greater decolorization than the rest of the solution.

The degree of decolorization obtained is noted in the following table, but it was insufficient to permit of the satisfactory polarization of any of the solutions.

TABLE I.

Series A.

Experiment No.	Sugar used.	N D_{100}	Anode Solution. Percentage of Colour removed.	Polarization.
15	Beet I.	·25	43·75	Doubtful
13	Beet I.	·25	32·26	Impossible
16	Beet II.	·25	Not measured	Impossible
38	Java Centrifugal	·34	83·33	Doubtful
39	Java Centrifugal	·25	76·66	Doubtful
40	Sandwich Islands II.	·43	77·55	Impossible
41	Sandwich Islands. I.	·43	75·67	Impossible

Series B.—As the results noted were so unsatisfactory, it was decided to retain the platinum electrodes but to use hydrogen peroxide in connection with water in making up the sugar solutions. Hydrogen-peroxide is an oxidant, and nascent oxygen to which it gives rise in contact with oxidizable substances, has long been known as a decolorizing agent.

While nascent oxygen does affect and decolorize organic acid salts, non-sugars and bodies of a colloidal nature, it does not attack or invert sucrose in neutral solutions.

Ample proof of this is noted in von Lippmann's *Chemie der Zuckerarten*[*] and similar evidence is given in the valuable paper by Otto Bismer, recently published.[†]

However, nascent oxygen alone—at least, as used under the conditions of the tests made, does not decolorize raw-sugar solutions sufficiently to permit of their polarization.

In Bismer's work the maximum decolorization obtained appears to have been only about 45%, and personal tests made on raw-sugar solutions with fresh hydrogen peroxide solution (3% strength) also proved its efficiency as a decolorant *per se* under the circumstances.

However, in passing an electric current from platinum electrodes through aqueous raw-sugar solutions containing some perfectly neutral hydrogen peroxide solution, a fair decolorization was secured in the cathode chamber.

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[*] III. Edition, 1904, p. 1234.

[†] *Oest. Ung. Zeitschrift*, 1905, Vol. XXXIV., p. 517.

The results obtained are given in the following table:—

TABLE II.

Series B.

Experiment No.	Sugar used.	N D_{100}	Cathode Solution. Percentage of Colour removed.	Polarizations determined in a tube of
50	Matanzas Centrifugal	·25	78·09	100 mm.
51	Porto Rico Muscovado	·25	57·89	100 mm.
52	Java Centrifugal	·25	65·38	100 mm.
53	Sandwich Islands III.	·25	73·07	Unsatisfactory
54	Sandwich Islands I.	·25	85·06	100 mm.
55	Sandwich Islands II.	·25	82·05	100 mm.

While these results show a marked improvement over those found in Series *A*, the decolorization secured was not yet sufficient to allow reliable polarizations to be made in a 200 mm. polarization tube. It was therefore decided to pass on to the use of soluble electrodes in place of the platinum electrodes thus far employed.

Series C.—In this experimental series both electrodes were made of sheet lead, and no hydrogen peroxide or any other reagent was used. The following data were obtained:—

TABLE III.

Series C.

Experiment No.	Sugar used.	N D_{100}	Anode Solution. Percentage of Colour removed.	Polarization determined in a tube of mm
6	Sandwich Islands I.	·25	86·84	200
28	Sandwich Islands I.	·25	94·83	200
29	Sandwich Islands I.	·16	93·10	200
30	Sandwich Islands I.	·13	87·93	100
4	Sandwich Islands II.	·25	94·12	200
25	Matanzas Centrifugal	·25	93·58	200
26	Porto Rico Muscovado	·25	85·29	100
24	Java Centrifugal	·17	96·15	200
14	Beet I.	·25	87·50	200
12	Beet I.	·25	91·94	200
27	Beet I.	·25	91·37	200
31	Beet I.	·33	93·54	200
20	Beet I.	·24	88·24	200
32	Beet I.	·25	85·18	200
21	Beet I.	·26	88·10	200
33	Beet I.	·23	87·50	200
18	Beet II.	·26	90·50	200
80	Sandwich Islands II.	·25	95·10	200
90	Sandwich Islands I.	·41	92·10	200

A glance at these results shows that the decolorization obtained was very satisfactory; considering all of the twenty experiments recorded on raw sugars of various origin and grades, an average decolorization of 90·56 per cent. was attained.

Series D.—In oxidation processes the energy with which the reaction proceeds at the anode is determined by the anode-potential. Frequently the oxidation of certain substances can thus be effected by a peroxidized anode that cannot be secured by a purely metallic anode having a lower potential pressure, and it was therefore determined to try some experiments in which the cathode should be of lead, but in which the anode of lead should receive a coating of lead peroxide, to learn whether possibly a still more efficient decolorization might be secured.

The peroxide plate was prepared in the following manner:—Three lead plates were thoroughly scoured with sand and water, then placed into a hot and fairly concentrated solution of caustic soda, and then after remaining therein for a few minutes, were thoroughly rinsed with clean water.

These three plates were then hung into a 20% solution of sulphuric acid as electrodes, the central plate was made the anode and the other two were linked as cathodes. An electric current, $N\,D_{100} = 2{\cdot}0$ amperes, voltage $= 2{\cdot}5$ volts, was then passed for thirty minutes. Should it be desired to coat only one side of lead plates with the lead peroxide, then two such plates can be prepared in one operation by making those two plates the anodes, and the central plate the cathode in the above sketched arrangement.

When peroxidized, the plate is washed thoroughly with water, then placed for three or four minutes in boiling water, thoroughly rinsed with alcohol and finally dried.

The data found in this set are given in the list appended:—

TABLE IV.

Series D.

Experiment No.	Sugar used.	$N\,D_{100}$	Anode Solution. Percentage of Colour removed.	Polarization determined in a tube of
42	Beet I.	·25	94·00	200 mm.
43	Sandwich Islands I.	·25	96·40	200 mm.
44	Sandwich Islands II.	·22	94·44	100 mm.
45	Sandwich Islands III.	·24	46·36	Not readable
46	Matanzas Centrifugal	·22	86·11	100 mm.
47	Sandwich Islands I.	·24	96·00	200 mm.
48	Porto Rico Muscovado	·23	86·68	100 mm.
49	Java Centrifugal	·12	97·50	200 mm.

With few exceptions the decolorizations obtained compare favorably with the results secured in series *C*, yet, the additional work necessary to prepare peroxidized electrodes appears to outweigh, or more than outweigh the slight advantage gained.

(To be continued.)

NATAL'S SUGAR INDUSTRY.

To those not thoroughly conversant with the circumstances of the sugar industry in Natal, its growth, present position, and future prospects will be matter for surprise. Started about the year 1850, in a very experimental fashion, it has gradually expanded until at the end of 1904 there was a capital of £1,324,095 embarked in it, 34 mills were in operation employing about 800 hands and some 33,000 acres were under cane. Its yearly sugar and molasses output, moreover, totalled about £2,600,000, and of rum about £30,000. So considerable a production naturally more than suffices for the Colony's own requirements, and since the Customs Convention has thrown open the markets of the other South African Colonies, it has contributed about one-half to South Africa's total consumption of sugar, and consequently has before it the opportunity of expansion to at least double its present productive capacity. This fact, of course, lends interest to the scheme for laying out lands in Zululand for sugar culture, to which allusion has been made, and more particularly so as soil and climate there are alike suitable for the growth of the cane. It also indicates the fact that, whatever may have been the rate of expansion of the industry in the past, there is room and inducement for an accelerated productivity, either by improved processes, improved machinery, or the enlargement of the acreage under cane, or all three methods simultaneously.

The attainment by the industry of its present dimensions has not been without cost, vicissitudes, and losses, and those who have recently embarked in sugar-growing are naturally reaping the benefit of their forerunners' experiences. In the early days each planter set up his own small mill, where he crushed his half-ton of cane a day. Thorough extraction was then out of the question, and working costs were high. The economies resulting from the central factory system soon, however, induced a new departure, and the first large steam-equipped mill in Natal was erected by planters from Mauritius in 1877-8, who brought trained workers and started the Natal Central Sugar Co.'s factory at Mount Edgecombe. The planter's individual mill is now the exception, and in its room there have sprung up about 34 large central factories, six of which are able to crush from 100 to 300 tons of cane per day of 12 hours, and the remainder ranging down to 14 tons per day.

The principal factories are the Tinley Manor (Messrs. Hulett & Sons, Ltd.), recently erected, with machinery from the works of Messrs. the Harvey Engineering Co., Ltd., Glasgow, capacity 200 tons of cane per day; the Tongaat (Tongaat Sugar Co., Ltd.), fitted with machinery supplied by the Mirrlees Watson Co., Ltd., Glasgow, capacity 270 tons; the Mount Edgecombe (the Natal Estates, Ltd.), equipped with machinery from Mauritius, capacity 300 tons; the

Réunion Estate (Mr. De Pass), with Jones and Abel's green megass furnaces, and Wetzel evaporators, capacity 180 tons; the Isipingo (Mr. Platt), with toggle gearing to the mill, and machinery by Messrs. Manlove, Alliott & Co., Ltd., Nottingham, the Mirrlees Watson Co., Ltd., Glasgow, and others, capacity 100 tons; the Esperanza Estates (Messrs. Reynolds Bros., Ltd.), with steel toggle gearing to rollers, Yaryan evaporators and electric driven centrifugals, capacity about 220 tons; Lower Illovo (Messrs. Pearce Bros.), and Umhloti Sugar Co., which has installed a Fryer's concretor. Besides these factories, the Natal Estates, Ltd., have a refinery at South Coast Junction of a capacity of 6000 tons of refined sugar per year, fitted with modern machinery, supplied by Messrs. D. Stewart & Co. (1902), Ltd., Glasgow. Stills for rum-making made by Messrs. Blair, Campbell & McLean, Ltd., Glasgow, are installed in the Esperanza and other factories.

While the larger factories are fairly up-to-date so far as machinery equipment and processes are concerned, many of the smaller factories are open to improvement in both particulars. The equipment of one of the largest mills, which is typical of the rest is as follows:—The mill is double, consisting of the first three rollers, an intermediate carrier for maceration, and the second three rollers. The juice from the crushed cane falls into the mill tank, whence, after straining, it is raised by a monte-jus to the sulphuring tank. Hence, after the addition of sulphurous anhydride and heating, it is passed to the tempering tanks, where lime is added until it becomes neutral. Then it is circulated through three vertical heaters, remains for a while in the subsiding tank, the clear portion then being syphoned off into the triple-effect, and the dregs pumped into filter presses, running thence to the quadruple-effect. Next the subsiders receive the concentrated liquid, the clear portion of which goes to the vacuum-pan feed-tanks, and then into the vacuum-pans, of 4 and 6 tons capacity respectively. Two of these pans are of copper, the third, of 20 tons, is of iron. The next stages of the juice are from the iron pan to the mixing tank and the water-driven centrifugals, of which there are six. The juice from the copper pans goes to ten smaller centrifugals, driven by belting. This is the final stage so far as the first sugars are concerned; but from the molasses four other grades of sugar are obtained, and these are sent to the refinery. In many factories Taylor bags, with or without eliminators, are still used, instead of filter presses, and at the Esperanza factory a Yaryan triple-effect has been installed. Where megass alone is used for fuel, efficient megass furnaces are installed, while toggle-gearing or hydraulic attachments are used in some mills to prevent overstraining of the rollers.

A feature of the Natal sugar industry is that, with the ceaseless extension of the acreage under cane, the equipment of the mills is being constantly outstripped, thereby creating the necessity for the frequent increase of their capacity. In addition, the reaching after more perfect results is the cause of many innovations in methods and appliances. In the opinion of Messrs. A. N. Pearson and A. Pardy, the introduction of the diffusion process in the larger mills is the only way to prevent the serious loss of sugar in the megass, but opinion is divided as to the value of the Naudet-Hinton process. More complete extraction of the sugar from the cane will likewise result from the increasing use of large central factories, while much advantage may be expected from the choice of better canes having increased sugar contents, new methods of culture, the use of multiple mills, &c. The greatest necessity which the industry lies under is, however, undoubtedly the invocation of the help of the chemist in the same way that his services are utilised in beet sugar culture. In field work, the disc plough is being introduced to aid the mould-board plough and the harrow while drill-ploughs are supplanting hoes. Finally, attention is now being directed to the use of phosphatic manures, bone dust, and other artificial substitutes for mill refuse, which has been the only manuring agent hitherto employed.—(*British and South African Export Gazette.*)

THE PRESENT CONDITION OF THE GERMAN SUGAR INDUSTRY.

At the annual general meeting of the German Raw Sugar Manufacturers, held in Munich last May, Dr. Mayer, of Berlin, read a paper on the present condition of the German sugar industry.

Although the Brussels Convention had been in force nearly three years, it was difficult to say whether it had been favourable or not to the German sugar industry, because the market was affected the whole time by abnormal disturbances independent of the Convention. Just previous to the latter coming into effect, very large exports occurred, which resulted in the considerable depletion of existing home stocks, which had to be made up by a large quantity of sugar, indicating an apparently large consumption. Next had followed a reduction in sowings and a very bad harvest, which, in conjunction with the Paris speculations, sent up prices very considerably. Finally came once more a big drop in prices.

For the next campaign a reduction in the sowings of 11½% was announced, but no one knew what the extent of the crop would be. It was rightly said that the Convention would favour Russia. This country had this year cultivated 560,000 hectares, or 35,000 in excess of last year, which was a big year in spite of the unfortunate social, political, and economic crisis the country underwent. When Russia once more had a normal crop, her sugar would enter into serious competition with other European sugars in the Eastern markets.

The beet sugar industry of the U.S.A. has increased largely. It has doubled within the last five years, but it still only amounts to 200,000 tons, and this thanks to a high protective tariff. The same also holds good in regard to the cane sugar industry in Louisiana. On the other hand the cane sugar industry flourishes in the Hawaiian Islands and Porto Rico. The Philippine production, which was once 250,000 tons, has fallen to 100,000 tons, but will no doubt rise again. That of Cuba increases rapidly and in large proportion.

The imports of sugar into the United States have been as follows (per cent.):—

Country of Origin.	1900.	1901.	1902.	1903.	1904.
Cuba	17·61	23·42	25·60	46·40	59·02
Dutch Indies	29·01	16·58	16·56	17·27	9·19
Hawaii	12·60	14·72	18·74	15·01	15·74
Germany	14·70	14·70	5·27	1·45	0·05
Other Countries	26·08	30·58	33·83	19·87	16·00
	100·00	100·00	100·00	100·00	100·00

It will be seen that Cuba has practically driven Germany out of the field and has considerably reduced the importation of cane sugar from Java and other non-American countries into the United States (the population of which latter is over 83 millions).

Here likewise (in tons of raw) are the imports into the United States of sugars below No. 16 D.S.

	1903.	1904.	1905.
Cuba	1,086,793	1,278,951	933,369
East and West Indies	561,922	284,360	499,883
South America	159,606	65,038	76,458
Philippines	8,516	27,928	35,380
Germany	33,878	1,117	91,483

The British Colonies have profited by the Brussels Convention, nevertheless imports into British India always exceed the exports, as is also the case in New South Wales. At the beginning of this year about 30,000 tons of German sugar was exported to India.

The sugar production of the Fiji Islands, amounting to 50,000 tons, goes to New South Wales, as does also the production of Queensland.

Most of the Mauritian crop goes to India, but a portion finds its way to the Cape.

The production of sugar in Jamaica, Trinidad, and Barbados is not of any great extent; it is exceeded by that of British Guiana, which has a production of from 100,000 to 120,000 tons.

Java's production has increased from 800,000 tons in 1901-02 to 1,000,000 tons in 1905-06. There exist other cane sugar producing countries of lesser importance. Such are Formosa, Brazil, Argentina, and Peru. Peru sent 5000 tons to England in 1901, and 50,000 tons this year.

Here are the figures of general exports of German sugar (in tons of raw):—

	1902.	1903.	1904.	1905.
Great Britain	760,173	680,343	661,347	567,894
Hamburg	7,762	202,397	2,397	36,836
United States	87,054	2,919	39.206	8,993
Canada	72,030	14,994	152	...
Japan	36,051	11,740	4,770	5,115
China	8,357	12,346	7,008	6,219
South America	6,612	10,379	13,748	12,762
Norway	32,856	29,523	25,322	23,345
Switzerland	26,267	26,512	19,838	23,969
Holland	33,534	31,011	12,602	26,397
Sweden	455	95	5,759	10,180
Denmark	11,129	16,596	2,866	10,777
Portugal	14,980	9,473	9,992	8,985

Exports to Canada have been stopped by changes in treaties. Those to Japan have diminished, as have those to Norway, while Sweden's share has increased and that of Holland has recovered satisfactorily.

Exports of German sugar at the beginning of this year were excellent, especially to England and India.

The consumption of sugar in the United Kingdom and the United States, which is on the average 88 and 79 lbs. respectively per head was not appreciably reduced by the rise in 1904-05, but the trade held aloof, and then imported large quantities at the beginning of this year.

In Germany and France, as a consequence of the reduction in duties, consumption has increased greatly; however, a still further increase was expected in Germany.

Here are some figures of German consumption and export (in tons of raw):—

	Consumption.	Exports.
1900-01	773,968	1,144,250
1901-02	743,520	1,216,486
1902-03	809,812	1,179,119
1903-04	1,130,326	873,623
1904-05	959,607	766,520

It is desirable that the duty on sugar be further reduced, but any such change seems out of question at present.

Dr. Mayer finally referred to the question of the renewal of the Brussels Convention, which step is opposed by the present majority in the British Parliament. He remarked that if Great Britain denounced the Convention, it would nevertheless continue in force. It would only be in the event of a second power denouncing it that a new Conference would require to assemble at Brussels (within the first two months of the year of denunciation) and decide what steps to take. Whether the Brussels Convention be renewed or not, it was to be hoped that events would prove to the advantage of the German sugar industry.

Dr. Schulz (Wulkow) remarked that the price of sugar, which was to-day already ruinous, might fall further to 15 fr., as it did in 1894 (1902?). But in order to remedy the situation it was no good looking to the Government for aid; they must help themselves.

In former days, when the Dutch or Portuguese had too large a crop of cinnamon or pepper, they used to jettison a cargo of these commodities so as to relieve the over-production. Again, in 1780 the Lyons merchants, having bought too much rice, threw the excess into the Rhone. Today one cannot employ such barbarous means, but if one cannot force men to eat more sugar, why not force the cattle to do so? By means of the Steffen process, the proportion of sugar produced can be reduced, while simultaneously supplying the cattle with a wholesome food. The animals could also be fed with the after-products.

He proposed the following resolution:—

The general assembly of the Raw Sugar Manufacturers' Section suggests to the Syndicate of German Sugar Manufacturers that ways and means should be found of lightening the market in the event of an excessive beet crop by using a considerable portion of the sugar, in particular as after-products, directly or indirectly in the feeding of cattle.

Dr. Brukner (Stralsund) approved of this resolution. He believed that the far too feeble increase in the consumption was caused by the rise in the price of meat, a necessary food; this had reduced the spending allowance of the working classes, who were in consequence obliged to buy less sugar, which was to them still only a luxury. By giving sugar to the cattle, it would stop the rise in the price of meat, and enable the working classes to use more sugar.

M. von. de Ohe did not agree with Dr. Brukner. He thought that the increased cost of meat had, on the contrary, had the effect of causing the labouring classes to replace it with sugar on their bread and butter. The consumption was not really so small as was supposed, for it was to be remembered that only 2½ years ago the stores were all empty and the then high consumption was only an imaginary one. One might be certain that the consumption would increase considerably this year, especially in view of a good fruit harvest.

Dr. Schulz' resolution was adopted with only three dissentients.—(*Sucrerie Belge.*)

A new Cartel has just been formed in Austria-Hungary to control the output. It is to run for two years, from October, 1906, to September, 1908, inclusive.

GUMMING OF THE SUGAR CANE.

Mr. N. A. Cobb, Director of Pathology and Physiology at the Hawaiian Sugar Planters' Experiment Station, has lately issued, an illustrated bulletin on the Gumming of the Sugar Cane.

As our readers may recollect, "gumming is a disease of the sugar cane that was first carefully investigated in the State of New South Wales in the early nineties." The interest aroused by the original reports soon spread, and led to the identification of this disease in other parts of the world, where likewise it has proved injurious. "It is in fact a disease of a very insidious nature, and one that usually attains a dangerous character before it is recognized. It is capable of doing a great deal of damage if left to itself, but fortunately its ravages are within our control by means of comparatively inexpensive precautions."

To detect the presence of this disease, it is necessary to examine the canes microscopically; but external symptoms are given by the presence of stalks with dead tops in the midst of stools of cane. "In such a case the base of the arrow will be found to be decayed. An examination of this part of the stalk will disclose one or more cavities, often of considerable size and more or less filled with a somewhat malodorous matter of the consistency of pus. About these cavities the tissue is dark in colour, being red, brown, or black, though sometimes the colour is lighter than this, and indeed in some cases may be altogether lacking. In all cases, however, these tissues are completely filled with slimy and offensive-looking matter."

If the stalks are then cut, it will be found that they tend to "bleed." "The liquid substance that slowly oozes out from the cut-off ends of the fibres has a yellow colour, and as a rule has about the consistency of honey, which it resembles in general appearance, though not in taste. . . . Sometimes the gum is transparent, sometimes it is more or less opaque."

The symptoms just described in brief are those to be observed in a marked case of the disease, and in crops that reach a stage suitable for crushing. They can generally be detected at the sugar mill carriers, for the cut-ends of the stalks exhibit all the colorations peculiar to the gumming. Plant cane has more pronounced symptoms than ratoon cane.

As to preventive measures to ensure immunity from gumming disease, the foremost step to take is to see that no gummed cane is used for planting. The old fallacy that anything is good enough for seed is a most pernicious one. Healthy cane alone should be used, and its appearance is such as one soon gets familiar with. Good drainage, too, decreases the loss due to gumming as well as that due to other diseases. After each cutting the trash should be completely burnt, as this destroys a vast number of germs. Even the soil may contain germs of disease, so that rotation of crops may do much to lessen infection. Failing rotation, a bare fallow every few years may have good effect.

Mr. Cobb sums up as follows:—

1. The disease first discovered in Australia and called the Gumming of the Sugar Cane is a very distinct disease, and is caused by the microbe *Bacterium vascularum* (Cobb) Greig-Smith.

2. Though the course of the disease is somewhat slow, it is often fatal, and may be the cause of most serious losses to the sugar industry in districts where it prevails.

3. The disease is most readily recognised in marked cases by the oozing out on the ends of fresh cuts of a yellowish gum or slime in small droplets, which appear first on the ends of the fibres, but finally often run together into larger drops.

4. The disease is one more particularly connected with the vascular bundles or fibres of the cane, but may extend in some cases to the parenchymatous tissue, more particularly at the base of the arrow, there causing a kind of top-rot characterized by the presence of much slime in cavities near the top of the stalk—cavities sometimes containing as much as a teaspoonful of gum.

5. Different varieties of cane vary remarkably in their susceptibility to the disease, some varieties being practically immune.

6. The disease is one that appears to be easy of control through the selection of sound sets or cuttings, and through the use of resistant varieties.

7. The disease is one that is *particularly liable to be transmitted from one country to another* through the medium of slightly diseased cuttings, as the amount of gum in such cuttings is too small to be noticed except through the agency of a microscopic examination.

For further details regarding the microscopic features of gumming (illustrated), the occurrence and spreading of the disease, and the chemical and physical properties of the gum, the reader is referred to the "*Third Report on Gumming of the Sugar Cane,*" by N. A. Cobb. Bulletin No. 3 Division of Pathology, Hawaiian Sugar Planters' Association, Honolulu.

Three well-dressed Austrian travellers were lately fined £75, £50, and £25 respectively, at a London Police Court for attempted smuggling of saccharine. It was stated in the evidence that saccharine could be bought for 3s. a lb., and sold in this country for 40s. per lb., so that the inducement to smuggle it in was very great.

THE SUGAR INDUSTRY IN SOUTH FORMOSA.

(Consular Report.)

The most conspicuous of the exports from South Formosa in 1905 were raw sugar, rice, hemp and salt, which monopolised respectively 66, 3, 2 and 1 per cent. of the total value of the export trade, the remaining 28 per cent. being assignable to other exports such as lungan, &c.

As regards raw sugar there was a gain of 46 per cent. as compared with 1904. The total amount exported in 1905 was 830,620 cwts. valued at £598,668, against 705,837 cwts. valued at £409,640 in 1904, showing an increase in value of £189,028 as compared with 1904. The average total value for the five years 1900–04 was £328,116, and shows an increase when compared with 1905 of £270,552.

The following table shows the quantity and value of raw sugar exported to Japan, and to China and Hong Kong respectively during 1905:—

Kind of Sugar.	Japan.		China and Hong Kong.		Total.	
	Quantity.	Value.	Quantity	Value.	Quantity.	Value.
	Cwts.	£	Cwts.	£	Cwts.	£
Brown sugar ..	827,674	595,831	1,151	848	828,825	596,679
White sugar....	119	156	1,676	1,833	1,795	1,989
Total.. ..	827,793	595,987	2,827	2,681	830,620	598,668

As compared with the figures for 1904 there is a large increase in the exportation to Japan of 153,211 cwts. and £291,806. Exports to China and Hong Kong decreased from 31,255 cwts., value £21,847, in 1904, to 2,827 cwts., value £2,681, in 1905, this decrease having helped to swell the increase in exports to Japan.

The export of white raw sugar to Japan and to China and Hong Kong reached a very low figure in 1905, having fallen from 54,232 cwts., value £49,997, in 1904, to 1,795 cwts., value £1,899, in 1905. This great decrease is mainly attributable to the fact that large quantities of white sugar which were exported in 1904 under the classification of white sugars were in 1905 exported under the classification of brown sugars. The tendency at present, however, is to manufacture brown sugars only, and the white grades which are now placed on the market are not so white as white grades of former years.

In consequence of over-speculation during the season 1904-05 the sugar market in Yokohama dropped from 12 yen per picul * (£1 5s.)

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* 1 picul = 133⅓ lbs.

in March, 1905, to 7 yen 50 sen per picul (15s. 7½d.) in October, 1905, and very heavy losses were incurred by all holders of sugar in South Formosa, so much so that a group of Formosan Chinese sugar merchants became financially embarrassed and practically ceased to export. As these merchants hitherto controlled about 50 per cent. of the sugar export and made large advances to various native mills whose products they control, their embarrassment had a widespread effect and hurried the financial crisis in South Formosa which, it had been anticipated, would occur if more specie were not sent out of the country for the purchase of new machinery. Prices opened in Tainan in the month of December, 1905, at 7 yen (14s. 7d.) per picul, rose to 7 yen 50 sen (15s. 7½d.) per picul only for a very short time, and then steadily declined, closing in May at about 6 yen (12s. 6d.) per picul. The crop for 1905-06 was a large one, more cane having been planted on account of the high prices obtained in the previous season. It was feared at one time that the financial crisis caused by the embarrassment of the native merchants already referred to might be so serious as to prevent the whole crop being reaped, owing to difficulty in borrowing the necessary funds to renew the mills, but the banks rendered financial assistance, and the crisis, although not quite over, is now less severe.

For foreign merchants the season has not been a bad one. Indeed the tightness of the money market amongst native merchants has had the effect of throwing a much larger share of the trade than usual into the hands of Europeans. And the comparative steadiness of prices has allowed of a brisk commission business with no speculation.

The year 1905 was characterised by the large number of native-owned semi-foreign style mills erected. With one or two exceptions the mills all employ foreign cane-crushing mills driven by steam or kerosene engines, but retaining the old style evaporating process. Forty-seven mills were erected, ranging in size from a crushing capacity of 40 tons per 24 hours to 200 tons; all were bought in Glasgow. As regards motive power, however, 15 sets of steam and 3 sets of kerosene motive powers were obtained from the United States owing to lower prices. There are now 67 new style mills with a total crushing capacity of 5,330 tons of cane in 24 hours, representing 60 to 70 per cent. of the total crop. Of these, six mills, representing a daily crushing capacity of 1,350 tons, make centrifugal sugar, while the remainder still manufacture the old style "brown sugar," but considerably improved in quality. It is expected that as the native Chinese become more experienced they will adopt more modern machinery and that eventually there will be a regular central factory system. Owing to the difficulties caused by inexperience in working new machinery, the 1905-06 crop has not been worked off as quickly as usual, and there is consequently a lesser area of cane planted for the coming season, 1906-07, than in 1905. This is partly due to the low prices received during the 1905-06 season. But although the area planted is less, it is expected that the new crop for 1906-07 will not be much smaller than that for the previous season on account of the large increase in Rose bamboo sugar-cane planted. This cane yields about three times the quantity, area for area, produced by the old style bamboo canes, which are rapidly being abandoned, and it is anticipated that within the next few years there will be no more old style bamboo canes left, except in places which are not suitable for the Rose bamboo. It is calculated that the output per acre from the old style bamboo canes is from 10 to 15 tons per acre, and from the Rose bamboo about 30 tons per acre.

GERMANY.

RESULTS OF THE CAMPAIGN OF 1905-06.

The number of factories at work during the season which lately closed was 376, an increase of two over the number in 1904-05. This number was, however, less than in previous years, as in 1903-04 there were 384 factories at work, and 393 in 1902-03.

The area planted with beets increased from 416,714 hectares in 1904-05 to 468,474 hectares in 1905-06, a hectarage which was only exceeded in 1901-02 with 478,749 hectares.

The quantity of beets worked up amounted to 15,726,425 metric tons as compared with 10,071,211 metric tons in 1904-05. The yield per hectare was 33·6 metric tons as compared with 24·2 tons in 1904-5, and 30·4 in 1903-04. While last year's figure was the lowest on record since 1874-75, this year's yield has only once been exceeded, and then in 1882-83, when 34·4 tons was the average.

The sugar production (in raw sugar value) was as follows:—

1905-06. Metric Tons.		1904-05. Metric Tons.		1903-04. Metric Tons.
2,311,746	....	1,503,036	....	1,650,980

The yield obtained was 14·70 per cent. as compared with 14·92% in 1904-05, 14·38 in 1903-04, and 14·47 in 1902-03.

The exports in raw sugar equivalent have been:—

1905-06. Metric Tons.		1904-05. Metric Tons.		1903-04. Metric Tons.
1,159,134	....	766,521	....	873,623

The consumption per head of the population was (in raw sugar values) 40·7 lbs. in 1905-06 and 35·3 lbs. in 1904-05.

A bill has just been introduced in the Danish Folkething embodying extensive reforms in the customs tariff. Amongst other changes, the sugar taxation is modified in such a way as to enable Denmark to join the Brussels Convention.

RECENT PRACTICE IN CANE SUGAR MACHINERY.

At a meeting of the Society of Engineers held at the Royal United Service Institution, Whitehall, on Monday evening, October 1st, 1906, Mr. Maurice Wilson, President, in the chair, a paper was read on "Recent Practice in Cane Sugar Machinery," by Perry F. Nursey, Past-President, and of which the following is an abstract:—

The author first referred to his previous paper of 1865 on the subject, which constitutes a correct exposition of sugar-mill engineering practice at that date. Since then, he observed, with the exception of a paper on American sugar mills, read before the Institution of Mechanical Engineers in 1902, and a few newspaper articles, there had been an absolute dearth of information upon the subject. He did not propose to follow in detail the development of sugar machinery during the forty years' interval, but to show the general trend of improvement as exemplified by the recent practice of sugar-mill engineers.

He then described an ordinary cane sugar-mill plant of the present day, and pointed out that from the 16 h.p. three-roller mill of 1865 we had now reached an eleven-roller plant, which included a pair of preliminary breaking rolls known as Krajewskis, being so named after their inventor. This was followed by descriptions and illustrations of examples of the present practice of various sugar machinery manufacturers as regards cane mills, both steam and electro driven. The firms represented included the Mirrlees Watson Company, the Harvey Engineering Company, Manlove, Alliott & Co., Ltd., D. Stewart & Co., Ltd., and Messrs. George Fletcher & Co. Centrifugal machines were represented by those of Messrs. Pott, Cassels & Williamson, which firm also manufacture Patterson's classifying apparatus. This is an ingenious contrivance for separating the washings from the syrup discharged from the centrifugal baskets, so that the washings may be returned to the vacuum pan to produce the same grade of sugar instead of passing away with the syrup into a lower grade.

Evaporators and vacuum pans as made by the Mirrlees and the Harvey Companies next came in for notice with illustrations, and included the Meyer film evaporator, which is made by Messrs. Fletcher. It consists of a revolving arm which sprinkles the juice over the heating surface in each evaporator vessel, and is applicable to existing evaporating apparatus. The author observed that although several improved systems of evaporation had been introduced since 1865, and the shape of the vacuum pan had been greatly altered, the old vacuum pan in the form of an oblate spheroid was still held by a few users to be preferable to some of the newer types on the grounds of common sense and scientific correctness.

The plant for the Naudet process of extraction and filtration of cane juice, as put down in Trinidad by the Harvey Company, was next described and illustrated. This process is one of diffusion or maceration by forced circulation, by means of which treatment it is claimed that within 0·50 of the total sucrose in the cane is recovered. It is stated that in Trinidad during the last crop the average extraction per 100 of sucrose in the cane was 93%, and on the weight of cane the sucrose content was 12·86%, and the recovery in juice 11·93%, leaving a loss in extraction of 0·93 on the weight of cane, or 7% on the 100 of sucrose in the cane.

A typical West Indian windmill sugar estate was then described, after which the author entered upon the consideration of the question of central factories. That system, he observed, constituted the most important advance of modern times as regarded the general conditions of sugar production, central factories having proved most successful, especially in connection with small estates. They were alike satisfactory to the owners of such estates, who sold their cane crops to the factory companies, and to the latter, who made the sugar and placed it on the market.

The author then described the Antigua central factory, the inception and inauguration of which were mainly due to the untiring exertions of the Hon. Francis Watts, C.M.G. It was erected and fitted under contract by the Mirrlees Watson Company in 1904, and the author pointed out that the report of the directors of the Central Factory Company for 1905 showed that the working of the factory for that year resulted in a net surplus of £3,956 9s. 8d. This result was obtained notwithstanding a prolonged drought; a saving point, however, was the somewhat advanced price of sugar during the early part of the year. The author then submitted a detailed specification of the plant and machinery of the Antigua factory, the cost of which, inclusive of several miles of light railway connecting up the various estates with the factory, was £42,408. The factory was handed over under steam to the company by the contractors within eleven months of the acceptance of the contract, and was publicly opened on December 19th, 1904.

The author finally described a modern Cuban central factory as erected and fitted by D. Stewart & Co., Ltd., and he concluded by stating that the Harvey Engineering Company had carried out contracts for no fewer than nine central factories in the East during the past five years.

The second number of the *Sugar Beet* (October) is a considerable improvement on the first, at least as regards number of pages, there being 50 % more matter. There are, however, very few long articles.

ON THE CAUSE OF COBB'S DISEASE OF THE SUGAR CANE.*

By Erwin F. Smith.

In 1903 Cobb published in Australia a very interesting communication concerning a so-called "gumming disease" of sugar cane which prevailed for some years in the vicinity of the Clarence River, and in other cane-growing districts of Australia. Cobb ascribed this disease to a bacterium. The prominent symptoms were a dwarfed growth, with rotting of the arrow or pith of the cane, and also, and this latter was constant, the occurrence of an abundance of yellow gum in the fibres of the stem. The bacteria were examined microscopically, and pictured; but not cultivated to any great extent; nor were they well characterized. Cobb proposed for the species the name *Bacillus vascularum*. He made some puncture inoculations on cane stems with yellow gum that had been taken from diseased stems, but no inoculations with pure cultures in the usual sense of the term. The results of the inoculations had not been secured at the time of writing.

In 1895 Cobb published the results of these inoculations as follows: They were conducted upon seven cane stalks which were selected on account of their healthy appearance, although they were standing in a region where the disease was very common. Unfortunately this garden plat was so far removed from Sydney that the inoculated stalks were not further observed for an entire year. They were then cut and forwarded to Cobb. One stalk had long since died; another was nearly dead, and it could not be said with certainty what had been the cause of death. All the other stalks of cane, inoculated as well as those not inoculated,† were infested with the gumming disease. Concerning the other cane stalks in the same garden, nothing is said, and no description is given of the symptoms during the course of the year.

In consequence, plant pathologists have expressed the opinion that the aetiology of this cane disease had not been fully cleared up. Some hold the opinion that the bacteria were only a saprophytic phenomenon of a subordinate nature; others are of the opinion that perhaps the disease was of a purely bacterial nature, but that the fact was not well established. For instance, Krüger writes in his work: "Das Zuckerrohr und seine Kultur."

"Zwar ist durch Reinkulturen und Infektionen die Ursache diesen Krankheit noch nicht unzweifelhaft erbracht, doch ist es sehr wahrscheinlich, das obige Krankheit dem Angriffe der genannten Bakterien zuzuschreiben ist."

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* "From Gumming of the Sugar Cane." Hawaiian Sugar Planters' Association Bulletins.

† This is not quite accurate. Some at least of the inoculated stalks never became infested. (*Note by N. A. Cobb.*)

In 1902 Greig-Smith published, also in Australia, an article concerning the gumming disease of sugar cane. He cultivated the organism in a pure condition and described its growth upon several culture media, but says nothing of infection experiments. His investigations were for the most part qualitative chemical tests concerning the nature and origin of the gum. From its reactions, which for the most part were the same as that of bacterial gum he bred in pure culture in agar-agar, he held it to be proved that the gum in diseased cane stalks must be of bacterial origin, and that in consequence this disease could not be other than of bacterial origin.

I do not know whether any one else, the author excepted, has bred this sugar cane disease in pure culture since the publication of Cobb's papers.

My own investigations began in 1901, but the first experiments miscarried. The cane stalks were very long in transit (5 months) and although much typical yellow gum was to be seen in the fibres, and with the aid of the microscope was recognizable as composed of bacteria, all these were dead. Cultures from it gave no result, or only scattered white and red colonies of saprophytic bacteria. From the copious yellow gum I unfortunately could obtain no yellow colonies. The cane stalk was so old, shrunken, and browned, that nothing else could have been expected.

In 1902 I received a second shipment of diseased cane stalks from Australia, through the kindness of the New South Wales Ministry of Agriculture. These stalks came through quicker, were sealed at the end with sealing wax, and, on examination, proved to be much fresher than the first shipment. When they were cut, a quantity of yellow gum exuded slowly from the fibres in drops, and was, as the microscope showed, composed of millions of bacteria, (nothing but bacteria could be found in the yellow fibres of the stalks). The stalks were two feet long, four to five centimetres in diameter, and contained hundreds of fibres filled with yellow gum. Other fibres, especially those near the margin, were reddish to brownish, and in this part I found a mycelium which, on being cultivated, produced a long-beaked Sphaeronema. Consequently I could not regard the red pigment with certainty as a symptom of the gumming disease, and I thought no more about it; but, as will be seen later on, this was not exactly correct. The mycelium itself was apparently a phenomenon of entirely subordinate character.

It was very easy, observing the well-known precautions, to isolate a yellow organism from out the yellow gum in really pure cultures. Plate cultures from two cane stalks, of which one (I.) was much fresher than the other (IV.) were prepared. On that prepared from Plate IV. colonies of mould, and of white and orange bacteria occurred. Upon the plate prepared from I. there was little else than Cobb's organism to be found, only scattered colonies of other bacteria. The inoculations were in consequence made from the yellow colonies from the cane stalk (I.). These yellow colonies were numerous and uniform. In the Petri-dishes, there were no mycelial colonies, and no reddish bacteria to be seen. The microscopical morphology, as well as the plate cultures, were entirely in harmony. Everything pointed to only a single yellow organism derived from the gummed fibres. This organism was a yellow, short-jointed motile schizomycete, characterized by a polar flagellum, which I assigned to the genus, *Pseudomonas*, under the name *Pseudomonas vascularum* Cobb).* The motile condition shows up much more clearly in young cultures than in old, or than if the bacteria are derived from vascular bundles. This restricted motility appears, however, in many other species of bacteria.

As I now possessed an excess of pure cultures, I tested the cultural peculiarities of the organism as described by Greig-Smith. These were quite correctly described by Greig-Smith. All doubts that I had on hand the same bacteria were dispelled by these studies. It was the same bacterium that Greig-Smith had described. I was therefore obliged to consider that it could be no other than that which Cobb had described in 1893-1895.

The next question, and the most interesting, as well from an economical as from a pathological standpoint, was this: Could I with these organisms produce the gumming disease in sugar cane? Were Cobb's declarations correct, as it seemed, or were they erroneous guesses like so many other pronouncements in matters pathological?

Fortunately I had at this time sound cane plants of four varieties in the green-house, which had newly come from plantations in Southern Georgia. These had been grown in the green-house for three months from healthy cuttings and were in good condition, about four feet high, with many leaves. The possibility of establishing infection by means of these organisms could therefore be tested through inoculations.

The inoculations were conducted by means of needle punctures on two leaves of each plant, at a point about one to two feet from the stem. Each leaf received twenty to thirty minute needle punctures on an area of about four square centimeters, but no injection. Only two plants were punctured on the stem, at about two feet from the ground; the results from these, however, presented no peculiarities. The inoculations were made with yellow gum from three potato cultures, which were five sub-cultures removed from the plate colonies. Up to night-fall, as is my custom, I protected the inoculated leaves from light with clean paper, but the needle punctures were not shut off from the air, which indeed they could not have been. A semi-tropical temperature was maintained in the green-house, and the plants grew rapidly.

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* At a later date, Dr. Smith referred this microbe to the genus, *Bacterium*, subdivision, *Pseudomonas*. (*Note by N. A. Cobb.*)

During the first week after the inoculation no symptoms could be noted, *i.e.*, the needle punctures themselves had not produced any. Many leaves were also punctured with sterile needles, indeed with many more punctures than the inoculated ones, but with no particular result, as was to be expected. About three weeks after the inoculation, white streaks were to be seen on the inoculated leaves, which soon became spotted with reddish or brownish flecks and stripes. These stripes had their origin in the inoculated parts of the leaf, and grew slowly backward as well as forward. For some weeks nothing more was to be seen except that the white streaks appeared on other leaves, and, somewhat later, reddish to brownish streaks appeared, accompanied by a shrinkage of the leaf parenchyma in stripes. At this time the dwarfing of the growth commenced, and in the end it became very noticeable. The row of inoculated plants remained much smaller than the uninoculated. After about three months the inoculated leaves, as well as other large leaves, shrivelled up, and the terminal bud became infested with a bacterial rot. At this time not all the leaves were dead, and the well-developed part of the stalk remained green and to outward appearance sound. Moreover, sprouts and roots started from the base of some specimens.

About twelve plants of the variety "common green cane" were inoculated, and all sooner or later showed these symptoms.

When the first symptoms were noticeable, I sectioned some of the inoculated leaves, and with the microscope could easily demonstrate the presence of the bacteria in the vessels for a distance of some 18 cms. upward. This was thirty days after the inoculation.

Later, as the general symptoms developed, I sectioned all the inoculated plants one after another, and examined them in all directions. The inner symptoms were the clearest. One could not wish or secure better results from any experiment. In every stalk there were numerous vascular bundles filled with the yellow bacterial gum, which oozed out in small drops if the stem was sectioned. Everything was as Cobb had described, and as I myself had seen in the specimens received from Australia, with the exception of the absence of saprophytic bacteria which during the six weeks' journey had developed upon the Australian specimens. Toward the top, close to the terminal bud, where the stem tissues were soft and not well developed, the gum was not confined to the vascular bundles. Here the parenchyma was also infested, in fact was so much infested that cavities of considerable size were filled with the yellow gum. Some of these cavities contained as much as a teaspoonful of yellow gum. This gum was also to be found in some vascular bundles at the base and middle parts of the leaves not inoculated, *i.e.*, leaves which had been infected through the agency of the vascular fibres. The inner face of many of the leaf-sheaths was also, after a few months, spotted red or brown and sticky with the outflow of bacteria. Among the inner leaves of the terminal bud this stickiness was so pronounced that the bud could not force its way through, and either took on a zig-zag course or became crumpled, whereby the terminal bud from without appeared somewhat clavate.

Examined under the microscope, this yellow gum showed millions of bacteria, but no fungus hyphae, nematodes or insects. Morphologically these bacteria were entirely the same as those which I had seen in the cane stalks which I received from Australia. Of course, if the pith-rot is sufficiently advanced, other organisms such as white bacteria and fungus hyphae are present, as, for instance, in the Australian stalk No. IV.

Plates flowed with agar-agar gave in Petrie-dishes an abundance of pure culture of the same yellow organism which I had secured from the Australian canes, and which I had inoculated by needle punctures into my cane leaves. Plate cultures gave the same results from various altitudes on several stalks. Bacteria were collected in great masses in pure culture in the yellow fibres of the stalk. Cultivated upon potato, agar-agar, gelatine, &c., the yellow gum displayed, whether examined by the naked eye or under the microscope, the same pecularities as the bacterial gum which was inoculated. I therefore consider the aetiology of this disease to be settled. The gumming disease of the sugar cane must be considered a purely bacterial malady whose cause is assignable to the yellow *Pseudomonas vascularum*. There can be no further doubt about it.

(To be continued.)

FRANCE.

Results of the Campaign of 1905-06.

The number of French beet sugar factories in operation during the 1905-06 campaign was 292, compared with 270 in 1904-05, and 292 in 1903-04. The area under beet cultivation is not yet definitely stated, but is unofficially estimated to have been 262,866 hectares, against 203,772 hectares (the official figure) in 1904-05, thus being a 29% increase on the previous season. This is the largest area sown since 1901-02.

The total production of sugar expressed in refined amounted to 984,671 metric tons (30·7 tons to the hectare), as compared with 562,736 tons (22·9 tons to the hectare) in 1904-05. The yield in sugar per cent. of beets was 12·18%, as compared with 12·05 the previous campaign.

MONTHLY LIST OF PATENTS.

Communicated by Mr. W. P. THOMPSON, C.E., F.C.S., M.I.M.E., Chartered Patent Agent, 6, Lord Street, Liverpool; and 322, High Holborn, London.

ENGLISH.—APPLICATIONS.

19464. E. SHAW, London. *Improvements in or relating to the process of extracting sugar from cane stalks.* 31st August, 1906.

20767. R. HARVEY, Glasgow. (Communicated by J. P. Rodriguez, Cuba.) *Improvements in and relating to mills for crushing sugar cane, or like material.* 19th September, 1906.

ABRIDGMENT.

18138. E. MONTI, of Turin, Italy. *Improvements in and relating to the treatment of wine must, beer, beetroot juice and the like.* 7th September, 1905. This invention relates to a process which consists in freezing the solution in a tub or tank of suitable height, by means of several superposed independent valve-controlled refrigerating coils in such a manner that the solution at the bottom is frozen last, the more concentrated solution which drips from the upper layers of ice crystals, and which sinks to the bottom of the tub, being frozen at a lower temperature than the less concentrated solution at the upper end of the tub.

GERMAN.—ABRIDGMENT.

172293. AUGUST NEUMANN, of Berlin, and WALTER RAABE, of Broistedt. *A saturating cone for diffusers.* 10th November, 1905. This saturating cone for diffusers is characterized by its being connected at its base with a pipe conveying fluid under pressure, and its walls being perforated at intervals with partially extending slots.

NOTE.—Copies of all published specifications with their drawings in these lists can be obtained from W. P. Thompson & Co., 6, Lord Street, Liverpool, at One Shilling a copy for English or American Patents, and Two Shillings for German. In ordering please give number and date.

Patentees of Inventions connected with the production, manufacture and refining of sugar will find *The International Sugar Journal* the best medium for their advertisements.

The International Sugar Journal has a wide circulation among planters and manufacturers in all sugar-producing countries, as well as among refiners, merchants, commission agents, and brokers, interested in the trade, at home and abroad.

IMPORTS AND EXPORTS OF SUGAR (UNITED KINGDOM)

To end of September, 1905 and 1906.

IMPORTS.

Raw Sugars.	Quantities.		Values.	
	1905. Cwts.	1906. Cwts.	1905. £	1906. £
Germany	3,769,613	6,652,998	2,204,850	2,858,337
Holland	91,610	88,733	63,722	37,356
Belgium	308,929	753,530	222,438	334,078
France	236,493	229,101	155,320	100,113
Austria-Hungary	370,920	176,738	243,766	72,627
Java	1,928,466	251,216	1,316,260	118,372
Philippine Islands	9,680	....	4,840	....
Cuba	....	111,910	....	41,943
Peru	995,924	471,111	657,278	212,099
Brazil	87,414	958,955	47,958	375,649
Argentine Republic	....	....	....	....
Mauritius	158,460	127,205	87,369	48,362
British East Indies	256,180	88,267	143,662	34,351
Straits Settlements	165,997	69,635	88,537	28,084
Br. W. Indies, Guiana, &c.	901,137	1,464,013	725,664	774,661
Other Countries	733,729	186,750	494,337	86,638
Total Raw Sugars	10,014,552	11,630,162	6,456,001	5,122,670
Refined Sugars.				
Germany	7,205,568	9,290,290	5,767,161	5,290,391
Holland	1,180,115	2,088,689	972,212	1,258,572
Belgium	189,478	312,038	155,639	181,328
France	1,491,796	2,082,288	1,102,102	1,172,747
Other Countries	344,392	507	282,051	367
Total Refined Sugars	10,411,349	13,773,812	8,279,165	7,903,405
Molasses	1,874,108	2,119,578	373,808	402,640
Total Imports	22,300,009	27,523,552	15,108,974	13,428,715

EXPORTS.

British Refined Sugars.	Cwts.	Cwts.	£	£
Sweden	184	128	168	115
Norway	15,624	13,929	11,969	8,286
Denmark	63,832	78,578	45,643	39,500
Holland	58,388	59,161	45,044	35,851
Belgium	6,595	8,488	4,291	4,879
Portugal, Azores, &c.	11,419	23,551	8,329	12,771
Italy	4,965	29,824	3,253	15,066
Other Countries	251,296	509,253	218,799	329,196
	412,303	722,912	337,496	445,664
Foreign & Colonial Sugars				
Refined and Candy	19,323	29,911	16,640	18,624
Unrefined	73,435	153,470	51,818	78,254
Molasses	2,752	5,490	840	1,761
Total Exports	507,813	911,783	406,794	544,303

UNITED STATES.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1906. Tons.	1905. Tons.
Total Receipts Jan. 1st to Oct. 18th	1,647,858	1,629,677
Receipts of Refined ,, ,,	1,705	1,233
Deliveries ,, ,,	1,691,543	1,553,637
Consumption (4 Ports, Exports deducted) since January 1st	1,649,900	1,475,630
Importers' Stocks, October 17th	14,848	76,040
Total Stocks, October 24th	147,000	220,150
Stocks in Cuba, ,,	16,000	139,000
	1905.	1904.
Total Consumption for twelve months	2,632,216	2,767,162

CUBA.

Statement of Exports and Stocks of Sugar, 1905 and 1906.

(Tons of 2,240lbs.)	1905. Tons.	1906. Tons.
Exports	945,063	1,110,685
Stocks	172,498	36,429
	1,117,561	1,147,114
Local Consumption (nine months)	32,120	32,570
	1,149,681	1,179,684
Stock on 1st January (old crop)	——	19,450
Receipts at Ports up to September 30th	1,149,681	1,160,234

Havana, September 30th, 1906. J. Guma.—F. Mejer.

UNITED KINGDOM.

Statement of Imports, Exports, and Consumption for Nine Months ending September 30th.

Sugar.	Imports. 1904. Tons.	Imports. 1905. Tons.	Imports. 1906. Tons.	Exports (Foreign). 1904. Tons.	Exports (Foreign). 1905. Tons.	Exports (Foreign). 1906. Tons.
Refined	664,255	520,567	688,691	1,000	966	1,495
Raw	540,971	500.728	581,508	4,563	3,672	7,673
Molasses	66,831	93,705	105,979	92	138	274
Total	1,272,057	1,115,000	1,376,178	5,655	4,776	9,442

	Home Consumption. 1904. Tons.	Home Consumption. 1905. Tons.	Home Consumption. 1906. Tons.
Refined	675,444	525,117	663,534
Refined (in Bond) in the United Kingdom	392,206	406,021	414,434
Raw	98,698	79,365	92,978
Molasses	58,202	86,238	97,644
Molasses, manufactured (in Bond) in U.K.	44,362	39,025	44,263
Total	1,268.912	1,135,766	1,312,853
Less Exports of British Refined	22,251	20,615	36,146
Total Home Consumption of Sugar	1,246,661	1,115,151	1,276,707

STOCKS OF SUGAR IN EUROPE AT UNEVEN DATES, OCT. 1ST TO 20TH, COMPARED WITH PREVIOUS YEARS.

IN THOUSANDS OF TONS, TO THE NEAREST THOUSAND.

Great Britain.	Germany including Hamburg.	France.	Austria.	Holland and Belgium.	TOTAL 1906.
134	118	356	88	31	726

	1905.	1904.	1903.	1902.
Totals	580 ..	773 ..	1161 ..	1123

TWELVE MONTHS' CONSUMPTION OF SUGAR IN EUROPE FOR THREE YEARS, ENDING SEPTEMBER 30TH, IN THOUSANDS OF TONS.

(Licht's Circular.)

Great Britain.	Germany.	France.	Austria-Hungary	Holland, Belgium, &c.	Total 1905-06.	Total 1904-05.	Total 1903-04.
1873	1163	651	561	199	4448	3685	4150

ESTIMATED CROP OF BEETROOT SUGAR ON THE CONTINENT OF EUROPE FOR THE CURRENT CAMPAIGN, COMPARED WITH THE ACTUAL CROP OF THE THREE PREVIOUS CAMPAIGNS.

(From Licht's Monthly Circular.)

	1906-1907. Tons.	1905-1906. Tons.	1904-1905. Tons.	1903-1904. Tons.
Germany	2,200,000 ..	2,415,136 ..	1,598,164 ..	1,927,681
Austria	1,375,000 ..	1,509,870 ..	889,373 ..	1,167,959
France	800,000 ..	1,089,684 ..	622,422 ..	804,308
Russia	1,300,000 ..	988,000 ..	953,626 ..	1,206,907
Belgium	275,000 ..	328,770 ..	176,466 ..	209,811
Holland	190,000 ..	207,189 ..	136,551 ..	123,551
Other Countries .	430,000 ..	415,000 ..	332,098 ..	441,116
	6,570,000	6,954,000	4,708,758	5,881,333

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☞ The Editor is not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

NOTES AND COMMENTS.

The Dutch Sugar Standards.

The Dutch Sugar Standards consist of a series of square glass bottles, each of them containing sugar crystals of a different shade in such an order that they form a continuous scale from No. 7 (the darkest) to No. 25 (the whitest). When using the Standard, one fills a spare empty flask specially retained for the purpose with the sugar to be tested and then compares its colour with that of the standard flasks in a diffused light, say, at a window where the sun is not at the time shining. As the sugar sometimes possesses a tinge quite different from any of those in the Standard set, a certain amount of experience and skill is necessary in order to judge with exactitude the shade to which this differing tinge is equivalent. This skill can only be obtained by practice and no rules can be laid down as to this point. Sometimes the sugar has a more blonde or a more greyish tinge than has the brown colour of the standard tint, and then it is rather difficult to hit upon the correct grade. In order to remain on the safe side in such a case as this, the Dutch manufacturers are very careful to deliver sugar not exceeding No. 13, when No. 14 is the maximum, as in America or Japan, for the lower duty; they never go as high as No. 14.

Further Extensions in the Cane Sugar Industry.

One result of the greater security felt in sugar making circles, as a consequence of the abolition of bounties and cartels, is the springing up of central sugar factories in districts where hitherto a number of small and obsolete independent mills have existed. One of the latest ventures is the formation of a new sugar company in Jamaica, named The Vere Estates Co., Ltd., which has acquired a very fine sugar property at Vere in that Island, and proposes erecting thereon a complete modern central sugar factory. The plant will include mills and crushers, all driven by one engine, improved clarification apparatus, large Harvey Triple Effects, with central condensation counter-current condenser, Torricellian column and dry air pumps, and crystallization in motion plant. A central sugar factory has also been ordered by the Japanese Government, to be erected at Loo Choo, Japan, and will be similarly fitted out. This last is intended for making white sugar direct from the cane, and will serve as a model for the extension of the cane sugar industry in Japan. In it it is intended to train a staff of both sugar engineers and sugar chemists for other projected Japanese factories. This shows that the Japanese are alive to the necessity and advantage of having at the head of the sugar factory a competent sugar engineer, as well as a thoroughly qualified sugar chemist, such as is, in every instance, the custom in all beetroot sugar factories on the Continent (but, unfortunately, is not at present usually the case in cane sugar factories), and the Japanese, although it is only a few years since they entered on this industry, are therefore moving on the proper lines. The contracts for both the above centrals have been secured by the Harvey Engineering Co., Ltd., Glasgow, and the work should keep their shops well employed for some time to come. It is gratifying to note that our Eastern ally, so long as she cannot produce what she wants in her own rapidly extending engineering establishments, places the bulk of her orders in the United Kingdom. In any case, however, American sugar engineers are hardly likely to be unduly favoured by Japan as long as the relations between the latter and the United States are so strained, in consequence of the high-handed action of the Californian education authorities in refusing the admittance of Japanese children to the "white" schools.

Disposing of Exhausted Beet Pulp.

The *Engineer*, in an article on the Italian sugar industry, mentions the fact that although most of the sugar machinery required in that country hails from Bohemia, yet Italian engineers are now beginning to compete. Among the most successful firms may be mentioned Signori Ceretti e Tanfani, of Milan, who have incidentally endeavoured to solve the problem of the economic disposal of the enormous masses of exhausted pulp issuing from the beet factories where diffusion is practised, and their patent design has succeeded in reducing the cost of transport by more than one-half. At Ferrara they have erected an overhead line capable of carrying away no less than 700 tons of pulp every 24 hours. From the upper storey of the factory a series of iron hoppers, each containing 650 litres, run in continual succession at intervals of 50 seconds round an overhead wire circuit and discharge their contents into a truck which, when full, descends an inclined plane and automatically empties itself at the required dumping ground. Another more complicated application of the same invention is to be seen at the Ficarolo sugar factory, where exists an overhead line over a kilometre long, which not only carries away the refuse but also the bags of finished sugar, and discharges into barges moored in a neighbouring river; on the return journey the necessities of factory life are brought in, so that no unprofitable haulage occurs.

Italy's Industrial Handicap.

The same article points out that, as compared with France, Germany, and especially Belgium, the Italian sugar industry suffers from a paralysing handicap, in the fact that there is an almost entire absence of native coal; and, needless to say, this is a mineral which is as yet absolutely necessary for the heating and evaporating processes. It is not, therefore, a matter of surprise to find that the potentiality of Italian factories averages no more than 800 tons per 24 hours, whereas in Belgium an output of 1,500 tons is attained in several works. In spite of this obstacle, however, the Italian sugar industry has assumed sufficiently large proportions to be able to employ about 12,000 hands during the campaign. This working season covers a period of four months, during which time the work never ceases day or night.

Revised Sugar Duties in Sweden.

The following statement shows the present rates of duty leviable on sugar imported into Sweden as compared with those previously in force:—

	Rates of Duty.			
	Present.*		Former.	
	Per kilog.		Per kilog.	
	Kron.	öre.†	Kron.	öre.†
Unrefined, up to No. 18, Dutch standard	0	24¾	0	23½
Unrefined, No. 18, Dutch standard and above....	0	30	0	33
Refined, including candy, loaf, and powdered sugar	0	30	0	33

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* These rates include the excise duty of 13 öre per kilog.

† 100 öre = 1 krona = 1s. 3½d. Kilog. = 3·2046 lbs.

Lord Denbigh on British Beet Growing.

At the first meeting of the winter session of the Central and Associated Chambers of Agriculture held at Ipswich the first week in November, the question of growing sugar beets came up for discussion, and amongst those who took part in the proceedings was Lord Denbigh. He sketched the rise of the new movement in favour of home beet sugar growing, and then went on to point out that the only chance of success lay in establishing large factories capable of dealing with not less than 40,000 to 50,000 tons in the season. It was not an industry that could with profit be begun in a small way. He naturally desired that the Government should come to the aid of the new industry for a few years, by granting a rebate on a portion of the excise duty. At present, however, the uncertain attitude of the Government towards the Brussels Convention would not encourage capitalists to come forward. They ought to be told with certainty the Government's intentions, because the Convention had brought a profitable industry within the reach of the British agriculturist. Another member of the Chamber who took part in the debate, and who hailed from Cheshire, stated that he could grow 50 or 60 tons of mangel to the acre; and it fetched the same price of beet. This certainly was a big crop.

A New Publication.

Our readers may be interested to learn that the series of papers by Mr. T. H. P. Heriot, which have lately appeared in this Journal under the title of "Simple Methods of Chemical Control," will shortly be published in book form. The author has, however, taken the opportunity for extensively revising his work by adding fresh matter and rearranging the order of the old chapters. The new book, which will appear under the name of *Science in Sugar Production: an Introduction to "Chemical Control" in Cane Sugar Factories*, will accordingly be enhanced in value and should find a place on the bookshelves of all those who desire to introduce into the cane sugar industry some form of control, however elementary, rather than to continue any longer the happy-go-lucky methods of a bygone ago, when factory losses were of no account, being overshadowed by the gains of abnormally cheap labour and a large market. The price of this new work will be 6s. net (postage extra), and copies may now be ordered from the Office of this Journal.

The Mirrlees Watson Co., Ltd., Glasgow, have just issued a quarto size catalogue illustrating their vacuum pans, and containing minute details of the sizes and capacities of the various types which can be supplied. Intending purchasers of new pans would do well to write for a copy.

SUGAR IN CANADA.

A Tariff Commission, sitting in Ottawa in the spring of this year, has been taking evidence with regard to sugar, some of which is interesting reading. A great fog of complicated and erroneous calculations unfortunately hangs about it and scares the general reader; but for those who can see through it there is a certain amount of vague illumination. It reminds us of the discussions of thirty years ago in the United States, when the American refiners were getting an "accidental" bounty on export, which those who desired its abolition had to prove to the U. S. Secretary to the Treasury at Washington. They did so, fortunately, by clear and conclusive figures, and therefore succeeded eventually in convincing the U. S. Treasury; but the struggle was long and arduous, so dense was the fog of erroneous "figuring" which had to be dispelled before light could be thrown on the scene.

So it seems to have been at Ottawa, and we do not yet know that the Commissioners have reached a glimpse of daylight; for their sakes we hope so. There is no real mystery, no need for all the confused calculations through which we have had to wade. The Canadian refiners enjoy a very large protective duty. The duty on refined is out of all proportion with the duty on raw sugar, and the refiner gets from the consumer the full duty paid price. There is no need for any elaborate calculations to prove the fact, it is patent in the Tariff book.

So much for the first bone of contention. Then comes the much more interesting question, from the British point of view, of the preferential duty on sugar from the British colonies. Here again we see no need for many words, far less for any confusing figures. The British West Indies produce more sugar than the whole of Canada can consume, that is the simple answer to the complaint that the preference goes into the pocket of the Canadian refiner not of the West Indian producer. If Canada were obliged to import large quantities of sugar from other countries which enjoy no preference, the West Indies would be in exactly the same position with regard to Canada that Cuba is with regard to the United States. They would at once fix such a price as would give them the full benefit of the preference—such a price, in fact, as would put their sugar, when duty-paid, on an exact level and equality with all other sugar imported into Canada.

But the West Indian producers are in the unfortunate position of producing more sugar than Canada consumes, and therefore they have no power to dictate terms. Their sugar, it is true, goes to Canada and enjoys the 33 per cent. rebate of duty, but it is the fortunate refiner who gets the benefit of that. It is so much extra profit to him because he still gets the full duty-paid price for his refined, just as if he had paid the full duty-paid price for his West Indian raw sugar. This then is a second big pull for him out of the tariff. We do not blame him, he really cannot help it; it is a natural consequence which he quite legitimately enjoys. We do not complain of his extra profits, but we do most sincerely regret that a preference meant for the benefit of British Colonies fails to reach them.

What will the Ottawa Commissioners do? Will they ever get out of this fog of figures without meaning and facts which have no existence? If they will turn their backs on misleading and bewildering "evidence" and simply read the tariff in the light of common sense, they may be able to see their way out of the difficulty. These few words may perhaps be of some assistance to them.

ELECTRO-DECOLORIZATION.

A Study in Optical Sugar Analysis.

By F. G. Wiechmann, Ph.D.

(Continued from page 566.)

Of the four experimental series tried, it would seem that Series *C* is the most simple and effective. Table V., following, contains the polarization values found in this series, and also the polarization values obtained on the same sugars after clarification with a minimum amount of basic lead acetate solution.

Table V.

Series C.

Experiment No.	Sugar used.	Polarization by		Result by Electro-method is + or −
		Ph. A sol. method.	Electro-method.	
6	Sandwich Islands I.	97·15	97·66	+ ·51
28	Sandwich Islands I.	97·29	97·60	+ ·31
29	Sandwich Islands I.	97·29	97·43	+ ·14
30	Sandwich Islands I.	97·29	97·58	+ ·29
4	Sandwich Islands II.	90·40	90·37	+ ·03
25	Matanzas Centrifugal	92·79	93·00	+ ·21
26	Porto Rico Muscovado	90·81	91·05	+ ·24
24	Java Centrifugal	97·77	98·00	+ ·23
14	Beet I.	94·23	94·40	+ ·17
12	Beet I.	95·69	96·23	+ ·54
27	Beet I.	95·86	96·32	+ ·46
31	Beet I.	96·15	96·39	+ ·24
20	Beet I.	93·72	94·15	+ ·43
32	Beet I.	93·75	94·17	+ ·42
21	Beet I.	94·75	95·20	+ ·45
33	Beet I.	94·47	94·79	+ ·32
18	Beet II.	91·60	91·69	+ ·09

(Current 10 minutes.)

Attention is invited to the last column of this table which shows the difference between the polarization values found by the two methods.

While it were idle to expect perfect agreement in duplicate analyses made by one, let alone made by two methods, yet it is peculiar that the results of the one method should in every instance be higher than the results of the other.

It is therefore proper and pertinent to look into this matter and to seek to determine, if possible, the cause of this discrepancy.

In this connection the following points might be considered. Is the increased polarization caused by

1. A concentration of the solution through:
    - (*a.*) Evaporation;
    - (*b.*) Electrolytic decomposition of the solvent;
    - (*c.*) Kataphoresis?
2. An alteration in the rotary power of:
    - (*a.*) The sucrose;
    - (*b.*) The invert sugar;
    - (*c.*) Other optically active bodies in the solution?

Each one of these questions shall be considered in turn.

Ad 1 (a).—Has a concentration of the solution taken place by evaporation? That sugar solutions experience a change in concentration while they are being prepared for observation in the saccharimeter is, of course, in a general way, well known.

However, it seemed desirable to collect some definite experimental data in this subject and to determine the extent of the evaporation error under ordinary conditions of work in a technical laboratory.

Raw sugars requiring clarification before polarization were selected for these tests and two series of determinations were made with them.

Series A.—In these tests no covers were used, neither on the filtering funnels nor on the receiving beakers.

Series B.—In these experiments both funnels and receivers were kept carefully covered by glass plates throughout.

The details of this work were as follows:

Weighings made:

(*a.*) 100 c.c. flask—empty.
(*b.*) Funnel and filter—empty.
(*c.*) Receiving beaker—empty.
(*d.*) 100 c.c. flask—contained all of the solution and precipitate.
(*e.*) Funnel and filter and precipitate and adherent solution.
(*f.*) Receiving beaker and filtrate.
(*g.*) Flask and remnant of solution and precipitate adherent to sides.

$d - a = x$, the weight of the solution + precipitate.
$e - b = y$, the weight of the precipitate + adherent solution.
$f - c = z$, the weight of the filtrate.
$g - a = w$, the weight of remnant solution and precipitate.

The manipulation being conducted without mechanical loss, $y + z + w = x$, *provided* there is no evaporation. If, however, there is evaporation, $y + z + w$ will be smaller than x and the numerical difference between the values will be a measure of the amount of concentration which the solution has experienced.

The apparatus used, sugar-flask, funnel and beaker, was of the kind regularly employed in the laboratory, diameter of beaker $= 2\frac{1}{3}$ in., diameter of funnel $3\frac{1}{4}$ in.; the flask was, however, provided with a ground-in glass stopper to prevent evaporation during the initial weighing of the solution.

The temperature of the room and the humidity of the same were noted in each instance.

The humidity of the air was determined by a dry and wet bulb thermometer, the indications being taken from a table of M. Glaisher's observations at Greenwich.*

Tabulation of the data obtained follows:—

TABLE VI.

Experiment No.	Temperature in degrees C.	Humidity in percentage.	Sugar used.	Polarization.	Evaporation loss in grms.	Time of filtration in min.
1A	21·67	78·8	Java Centrifugal	96·9	0·76	20
1B	23·89	69·9	,, ,,	96·8	0·20	25
2A	24·44	66·2	,, ,,	97·1	0·56	27
2B	25·00	60·5	,, ,,	97·0	0·22	25
3A	23·33	57·6	Cuba Mol. Sugar	85·6	0·33	10
3B	23·33	57·6	,, ,, ,,	85·6	0·13	10
4A	20·00	63·8	Java Centrifugal	97·70	0·26	4
4B	22·22	69·0	,, ,,	97·67	0·23	4
5A	20·83	64·25	Iloilo Mat	88·43	0·18	7
5B	21·11	64·4	,, ,,	88·40	0·07	7
6A	20·00	52·4	Java Centrifugal	97·45	0·21	6
6B	19·44	52·0	,, ,,	97·40	0·07	6
7A	20·00	63·5	Mol. Sugar	86·30	0·13	13
7B	20·00	63·5	,, ,,	86·00	0·04	13
8A	21·11	54·0	,, ,,	85·68	0·21	13
8B	21·11	54·0	,, ,,	85·68	0·07	13
9A	20·55	55·5	Java Centrifugal	97·30	0·13	5
9B	20·55	55·5	,, ,,	97·28	0·07	4
10A	20·55	60·0	,, ,,	97·37	0·19	4
10B	20·55	60·0	,, ,,	97·30	0·09	4

Of course only the data of Series B can come in for consideration, those of Series A merely demonstrating the very serious error introduced by a neglect to keep all vessels carefully covered during filtration while preparing a sugar solution for polarization. It will be noted that the temperatures at which these experiments were made range between 19·44° C. and 25·0° C.

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* Thomas Box, A Practical Treatise on Heat as Applied to the Useful Arts, p. 138, 8th Ed. 1895. London and New York.

In all experiments made in the electro process, scrupulous care was taken to keep the solutions covered throughout in order to reduce the loss by evaporation to a minimum, and in this respect these results are therefore as reliable as any of those just tabulated.

In order, however, to learn whether the electric current passed through the solutions might cause any appreciable heating of the solutions and thus induce evaporation, careful note was made of the temperatures of the solutions immediately before and immediately after the passing of the electric current.

These changes in temperature were as follows :—

Experiment No.	Temperature of Solution in Degrees Centigrade. Before.	After.	Anode Solution is ± original solution. Degrees Centigrade.
6	17·0	17·5	+ 0·5
28	21·0	20·0	— 1·0
29	23·5	22·0	— 1·5
30	—	18·0	not taken
4	18·0	19·0	+ 1·0
25	20·5	21·0	+ 0·5
26	20·5	20·5	0·0
24	18·5	18·5	0·0
14	18·5	20·0	+ 1·5
12	19·5	20·0	+ 0·5
27	23·0	22·0	— 1·0
31	22·0	20·0	— 2·0
20	21·5	22·0	+ 0·5
32	20·0	18·0	— 2·0
21	21·0	21·5	+ 0·5
33	20·0	20·0	0·0
18	18·0	19·0	+ 1·0
80	21·0	22·0	+ 1·0
90	20·0	20·0	0·0

The time it took to carry out these tests did not exceed the average duration of the filtration tests just discussed. The actual temperatures of these experiments ranged between such narrow limits and the variation during any one individual test was so small, that the temperature factor in these experiments can certainly not have exercised any appreciable influence on the rate of evaporation on these solutions. In other words, no appreciable concentration over and above the concentration unavoidable in regular polariscopic work can have been induced by the passing of the electric current.

Ad 1 (b).—Has a concentration of the solution taken place by electro-decomposition of the solvent ?

This question can readily be answered in the negative.

One coulomb of electricity decomposes 0·0945 milligramme of water. The international coulomb is the quantity of electricity transferred by a current of one international ampere in one second.

In most of the experiments recorded 0·25 ampere was passed through the solution for 300 seconds, which corresponds to 0·25 × 300 = 75 coulombs in all.

$$1 : 75 :: \cdot0945 : x$$
$$x = 7\cdot0875$$

that is to say, the electric current in the five minutes during which it passed through the solution decomposed 7·0875 milligrammes of water.

The total mass of solution acted upon electrolytically was 75,000 milligrammes, therefore the solution must have been concentrated by this cause to the extent of:

$$75000 : 7\cdot0875 :: 100 : x$$
$$x = 0\cdot0094 \quad \text{per cent.},$$

an amount which could not cause any measurable increase in the polarization of the solution.

Experimental test of this point was moreover made by subjecting a normal weight solution of a granulated sugar to the electro process, under conditions identical with those obtaining in all of the raw sugar experiments of Series C, except that platinum electrodes were used in place of lead electrodes. The following were the data secured:—

	Specific Gravity.	Polarization.
Before electro action	1·0995 ..	99·69
After electro action	1·0997 ..	99·71

The temperature of the solution was, before electro action, 20·0° C.; after, 21·5° C.

Hence it appears that the combined effect of the rise in temperature and of the concentration of the solution electrolytically amounts to 0·02 %—an amount well within the limits of error of the most exacting polariscopic determinations.

Ad 1 (c).—Can kataphoresis cause a concentration of the solution in one of the electrode chambers?

By kataphoresis there is understood the passing of the contents of one electrode chamber into the other, through a diaphragm; in aqueous solutions generally from the anode to the cathode compartment. This phenomenon is independent of electrolytic action, and is not subject to the laws of Faraday.

Obviously the simplest way to settle this question was to prepare a sucrose solution, to pass the electric current through the same, and then to determine the specific gravity of the anode and the cathode solutions.

The work was done on a normal weight solution of a granulated sugar, having a polarization of 99·71.

The temperature of this solution was:—

Before electro-action = 20·0° C.
After electro-action = 20·5° C.

After the current had passed for five minutes the specific gravity of the anode solution = 1·1004.
cathode solution = 1·1006.

The polarizations of these two solutions also agreed within 0·02° Ventzke.

Kataphoresis may therefore be excluded from consideration as a possible source of the increased polarizations noted.

Ad 2 (a).—The question whether or no the passing of an electric current under the conditions used in the electro method affects the rotatory power of sucrose was tested as follows:—

Exp. 1.—The refined sugar was prepared for polarization without any clarification. Pol. = 89·52.

Part of this solution was placed into the electro-cell with lead electrodes but without any parchment or other septum, and an electric current $ND_{100} = 0{\cdot}25$
Volts = 4·10
was passed through the solution for five minutes. Pol. = 89·51. Hence, no alteration.*

Exp. 2.—A refined sugar (granulated) was prepared for polarization without any clarification, Pol. 99·90.

Part of this solution was placed in the electro-cell, a parchment inserted, lead electrodes were used and an electric current of $ND_{100} = 0{\cdot}36$, volts = 9·5 was passed for five minutes.

Anode solution	Pol. = 99·98
Cathode solution	Pol. = 99·94

Hence no alteration.†

Exp. 3.—(*a.*) A solution of a granulated sugar was prepared by dissolving 26·000 grammes in pure water up to a volume of 100 metric cc. Pol. = 99·74.

(*b.*) A solution of the same granulated sugar was prepared by dissolving 26·000 grams in water, adding 10 cc. of basic lead acetate solution (Int. Com. standard) and bringing the solution up to a volume of 100 metric cc. This solution was passed through a double S and S. filter and then polarized under observance of all precautions. Pol. = 99·76.

(*c.*) Part of this solution *b* was then placed into the square cell with lead electrodes, without any septum, and an electric current of $ND_{100} = 0{\cdot}51$, and of 3·45 volts, was passed for five minutes. Pol. = 99·72.

Hence, no alteration.

These tests certainly prove that the rotatory power of sucrose is not affected by the electric current used in the process.

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* A duplicate of this experiment with platinum electrodes gave Pol. = 89·50.

† A corresponding experiment on a granulated sugar with platinum electrodes gave

Original Pol.	= 99·83
Anode Pol..	= 99·87
Cathode Pol.	= 99·87

Ad 2 (b).—To determine whether the rotatory power of invert sugar is altered by the electro-process the following tests were made :—

Exp. 1.—A high-grade granulated sugar was inverted with hydrochloric acid and polarized. Pol. = —17·24.

An electric current $ND_{100} = 0{\cdot}13$, voltage = 2·89, was then passed through this solution for five minutes.

Anode solution Pol. = —17·32.

Hence, practically no alteration.

Exp. 2.—A high-grade refined sugar was partially inverted with hydrochloric acid and polarized. Pol. = —13·66.

An electric current $ND_{100} = 0{\cdot}15$, voltage = 2·8, was then passed through this solution for five minutes.

Anode solution Pol. = —13·76.

Hence, practically no alteration.

These results show that the rotatory power of invert sugar is not altered by the process.

Ad 2 (c).—Is the rotatory power of any other optically active constituent of the sugar solutions altered by the process ?

In all of the experiments made, record was kept of the chemical reaction of the solutions before and after the passing of the electric current.

The following table embodies these data :—

TABLE VIII.

Experiment No.	Reaction with	Original Solution.	Anode Solution.	Cathode Solution.
6	Litmus	sl. acid	acid	alk.
	Phenol Phthalein			alk.
28	Lit.	sl. acid	acid	alk.
	Ph. Ph.			alk.
29	Lit.	sl. acid	acid	alk.
	Ph. Ph.			alk.
30	Lit.	sl. acid	acid	alk.
	Ph. Ph.			alk.
4	Lit.	neutral	sl. acid	sl. alk.
	Ph. Ph.			alk.
25	Lit.	acid	acid	alk.
	Ph. Ph.			alk.
26	Lit.	acid	acid	alk.
	Ph. Ph.			alk.
24	Lit.	acid	acid	alk.
	Ph. Ph.			alk.
14	Lit.	neutral	sl. acid	alk.
	Ph. Ph.	neutral		alk.
12	Lit.	acid	acid	sl. alk.
	Ph. Ph.			sl. alk.
27	Lit.	sl. acid	acid	alk.
	Ph. Ph.			alk.

Experiment No.	Reaction with	Original Solution.	Anode Solution.	Cathode Solution.
31	Lit.	neutral	sl. acid	alk.
	Ph. Ph.			alk.
20	Lit.	acid	sl. acid	strongly alk.
	Ph. Ph.			strongly alk.
32	Lit.	sl. acid	sl. acid	alk.
	Ph. Ph.			alk.
21	Lit.	neutral	neutral	alk.
	Ph. Ph.			alk.
33	Lit.	acid	acid	alk.
	Ph. Ph.			alk.
18	Lit.	acid	acid	alk.
	Ph. Ph.			alk.
80	Lit.	neutral	sl. acid	alk.
	Ph. Ph.			alk.
90	Lit.	sl. acid	acid	sl. alk.
	Ph. Ph.			sl. alk.

It will be seen from this table that in every instance the anode solution—the solution used for polarization after the electro treatment—reacted acid, whatever the reaction of the original solution might have been.

Now, it is well known that some organic non-sugars which are optically active, experience a change, in some cases even an absolute reversal of their optical rotation value, according as their solutions are acid or alkaline.

Asparagine and some of its derivatives, for instance, act in this way.

Asparagine, which when decomposed yields ammonia and aspartic acid, exhibits levo-rotation in aqueous solutions, an increased levo-rotation in alkaline, but a dextro-rotation in acid solutions.*

The high polarizations observed may hence have been caused by this or a similar substance. A probable indication of its presence was, moreover, the strong ammoniacal odour noticeable in several instances in the cathode solutions during the electro treatment, and the marked deepening of the colour of these cathode solutions.

Asparagine is present in beets to the extent of possibly from 0·1 to 0·2 %. It also occurs in cane products. Thus Maxwell writes:—"Asparagine is present in cane-juice, especially that from immature cane; it is changed to aspartic acid by the action of lime, and as a lime salt is found in molasses."†

Aspartates are levo-rotatory in alkaline solutions and dextro-rotatory in acid solutions.‡

To settle this issue, Champion and Pellet's method§ was tried.

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* A. Rümpler, Die Nichtzuckerstoffe der Rüben, 1898, pp. 270, 271.

† Bull. 38. 2nd Series Louisiana Experiment Station, p. 1380.

‡ S. L. Spencer, A Handbook for Cane Sugar Manufacturers and their Chemists. 4th Edition, 1906, p. 89.

§ Compt. Rend., 1876, Vol. 82, p. 819.
Zeitschrift d. Vereins f.d. Rübenzucker-Industrie, 1876, Vol. 26, p. 819.

After electro treatment and after subsequent polarization of the anode solution, 10 % of an 8 % aqueous solution of acetic acid were added to the anode solution and the same re-polarized.

In case asparagine or one of its derivatives should prove to be responsible for the increased polarizations, lower values should be found after use of the acetic acid.

The following table embodies the results obtained:—

TABLE IX.

		Polarization determined by		
Experiment No.	Sugar.	Basic Lead Acetate Sol.	Electro-method.	Electro-method + 10% acetic acid solution.
1	I. Beet	95·70	96·58	95·63
2	Java Centrifugal	97·60	98·00	97·64
3	Java Centrifugal	97·60	98·17	97·57
4	Matanzas Centrifugal	92·59	93·14	92·55
5	Porto Rico Muscovado	90·66	90·87	90·61
6	Sandwich Islands I.	97·21	97·56	97·13
7	Sandwich Islands II.	90·48	....	90·46

From this table it appears that the differences between the results of the polarizations obtained by clarification with basic lead acetate solution and by the electro-method after use of acetic acid, are:—

Experiment No.	The Electro-result is ±
1	— 0·07
2	+ 0·04
3	— 0·03
4	— 0·04
5	— 0·05
6	— 0·08
7	— 0·02

In other words, these results are identical, the average variation being less than 0·05° Ventzke.

The practical working of the electro method for decolorizing sugar solutions may hence be summarized as follows:—

Dissolve 26·000 grams of sugar with pure water up to a volume of 100 cubic centimetres, at a temperature of 20° Centigrade.

Place about 35 cc. of this solution into each of the two chambers of the electro-cell previously described, and pass an electric current of approximately $N.D._{100} = 0\cdot25$ through the solution for five minutes.

Discharge the solutions separately. Filter the anode solution perfectly clear into a graduated receiver, add to this solution 10% of its volume of an 8% acetic acid solution, and polarize. To the reading observed on the saccharimeter add 10 % to compensate for the dilution caused by the addition of the acetic acid solution. The result is the polarization sought.

In these experiments lead electrodes have been used. On theoretical grounds possibly insoluble electrodes might be preferable, and experiments are now in progress in my laboratory in which platinum electrodes and platinum electrodes coated with platinum black are used in their stead.

The amount of lead which passed into the solution in these experiments was, however, only trifling.

Thus in

Experiment No.	Lead lost from the Anode. Gr.	Lead lost from the Cathode. Gr.
3	0·0558	0·0288
4	0·0551	0·0093
5	0·0260	0·0118
6	0·0319	0·0045
7	0·0255	0·0030

These same sugars required for their clarification by basic lead acetate solution as minimum amount of this re-agent:—

Experiment No.	3	1 cc.
,,	4	3 ,,
,,	5	2 ,,
,,	6	1 ,,
,,	7	3 ,,

Accepting the molecular formula of basic lead acetate as

$$[2\,Pb\,(C_2H_4O_2)_2 + Pb\,(OH)_2]$$

this compound has a molecular weight of 774·7, the lead in it a total atomic weight of 620·7.

1 cc. of basic lead acetate solution as used contained 0·3399 gr. of the basic salt, equivalent to 0·2723 gr. of metallic lead. Hence, to decolorize the sugars referred to there was used of lead, in

Experiment No.	Basic Lead Acetate Method. Gr.	Electro-Method. Gr.
3	0·2723	0·0558
4	0·8169	0·0551
5	0·5446	0·0260
6	0·2723	0·0319
7	0·8169	0·0255

or, in the electro method, on an average, only 7·14% of the amount used in the clarification by the basic lead acetate solution. Of course, in the electro method the precipitate error is entirely obviated as the lead enters the solution only after the same has been made up to its proper volume.

The greatest difficulty which had to be overcome in the working out of this electro method, was the disturbing influence exercised by some of the organic non-sugars on the optical test.

In an interesting resumé entitled, "Errors in the Polarimetric Determination of Sucrose," recently published in the *International Sugar Journal*,* the following statement occurs:—

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* January, 1906, pp., 10-16.

"It is somewhat strange to record that the most serious of all polarimetric errors has received the least attention on the part of the investigators; we refer, of course, to the indirect action of the basic and neutral acetates of lead on the optical activity of saccharine solutions containing invert sugars."

There is perhaps less of a lack of attention and effort, than a lack of success, to be noted on the part of the investigators of this matter, caused by the very great difficulties which surround the problem.

It is impossible to review here the many papers which have been published dealing with the influence of basic lead acetate on polarization. Constant reference is made to this matter in the current technical literature. The condensed discussion which we find on this subject in von Lippmann's classic *Chemie der Zuckerarten* (third edition, volume 2, pages 1371-1373), cites no less than fifteen investigators who have turned their attention to this matter.

From some of the evidence thus collated by von Lippmann it appears that the presence of basic lead acetate may bring about polarization values *lower than the truth* on account of the possible precipitation of sucrose by the basic lead acetate, on account of the presence of certain salts, of alkalies, &c.

On the other hand, as Degener* pointed out, even a slight excess of basic lead acetate suffices to impart a marked dextro-rotation to malic, tartaric, asparaginic, glutamic, and arabinic acids, as well as to asparagine and to glutamine, and this would, of course, *increase* the polarization readings above their true value.

For instance, in some of his investigations, Degener found the following experimental results:—

In 100 cc. of solution there are contained asparagine:—

			$[\alpha]$ D.
I.	2·6685 g.	without basic lead acetate	— 5·12°
	0·6671 g.	with a few drops of basic lead acetate ..	+ 36·26°
	0·6671 g.	with a great excess of basic lead acetate	+ 59·56°
II.	2·000 g.	without basic lead acetate	— 5·18°
	0·100 g.	with 10 % of basic lead acetate, as in juice polarizations.	+ 61·76°
	0·200 g.		+ 69·10°
	0·400 g.		+ 66·59°

Commenting on these data, Rümpler (lib. cit., p. 285) states: "By addition of basic lead acetate to an aqueous solution of asparagine, the levo-rotation of this substance is changed to dextro-rotation which, if an excess of basic lead acetate be used, is approximately the same as that of sucrose. Hence, in the customary polarization of juices, every tenth of a per cent. of asparagine is taken for a tenth of a per cent. of sugar."

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*Zeitschrift des Vereins für Rübenzucker-Industrie, 1884, vol. 34, p. 637.
Ibid, 1885, vol. 35, p. 121.

Asparagine is also at times responsible for the low sucrose values returned by the gravimetric determinations with Fehling's solution, for small amounts of asparagine, especially in the presence of invert-sugar, interfere considerably with the proper precipitation of cuprous oxide.*

The situation is indeed a very trying one if the raw sugars to be prepared for polariscopic observations are colonial products, *i.e.*, are cane products. There the normal presence of invert sugar, of dextrose, and of levulose, complicate matters considerably; for, not only do these sugars by their presence interfere with the polariscopic reading which *nominally* is supposed to indicate sucrose, but they are variously affected by the reagent used for clarification.

While the rotatory power of dextrose is not materially affected by basic sub-acetate of lead, that of levulose is considerably lowered. But levulose, in the presence of certain salts, is partially precipitated by this reagent, and this leads to an increased dextro-rotation owing to the then predominating influence of the dextrose.

To learn what differences might be found between the polarization values of colonial sugars closely analogous in composition to those experimented with in the electro-process, the following methods were employed:—

A. Direct polarization after decolorizing with basic lead acetate solution.

B. Corrected polarization after determination of the lead precipitate error. (Wiechmann's method.)

C. Direct polarization after decolorization with dry basic acetate of lead. (Horne's method.)

D. Gravimetric determination with Fehling's solution.

The results are noted in the following table:—

Polarization-value determined by methods.

Sugar.	A.	B.	C.	D.	
				Sucrose.	Invert Sugar.
Sandwich Islands I.	96·89	96·69	96·90	95·24	0·61
Sandwich Islands II.	90·40	90·21	90·39	88·70	3·94
Sandwich Islands III.	88·20	87·70	88·08	87·00	3·15
Java Centrifugals	97·58	97·52	97·42	95·70	0·78
Matanzas Centrifugals	92·73	92·56	92·60	91·56	2·55
Porto Rico Centrifugals	90·12	89·87	90·07	88·12	2·94

Again selecting the customary basic-lead-acetate solution method as the standard for the purpose of comparison, it appears that the results of the other methods differ from the results of the basic-lead-acetate solution method as follows:—

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* Centralblatt f.d. Zucker-Industrie der Welt, 1897, Vol. 5, p. 938A.

TABLE XI.

Differences in the Polarization-values determined by methods.

These are ± the Polarization-values of Method A.

	B.	C.	D.
Sandwich Islands I.	— ·20	+ ·01	— 1·65
Sandwich Islands II.	— ·19	— ·01	— 1·70
Sandwich Islands III.	— ·50	— ·12	— 1·20
Java Centrifugals	— ·06	— ·16	— 1·88
Matanzas Centrifugals	— ·17	— ·13	— 1·17
Porto Rico Centrifugals	— ·25	— ·05	— 2·00
Average for all of these grades of sugar	— ·23	— ·08	— 1·60

Truly, Santayana has well said,

> " Our knowledge is a torch of smoky pine,
> That lights the pathway but one step ahead."

THE IMPERIAL DEPARTMENT OF AGRICULTURE IN THE WEST INDIES.

At the lecture delivered by Sir Daniel Morris, K.C.M.G., in July, on " Sea Island Cotton in the West Indies," before the members of the West India Committee, Mr. Harold Hamel Smith inquired what steps had been taken to put the Imperial Department of Agriculture on a more permanent basis, as he believed that its time expired next year, and he wished to know if anything had been done to renew the grant for it. In reply to this, Sir Daniel, as the Commissioner, said that as to the future of the Department he was not without hope that it might be possible to continue it for some years longer, as he was convinced that it was capable of showing even better results than at present.

We are now pleased to see that on November 12th, Mr. Mitchell-Thompson, M.P. for Lanark, and a member of the Executive of the West India Committee, asked the Under Secretary for the Colonies whether H.M. Government had yet decided as to the continuance of the Imperial Department of Agriculture in the British West Indies, and whether representations had been received as to the importance of the continuation of the work of the Department.

Mr. Winston Churchill replied that the continuance of a grant from Imperial funds in aid of the Department mentioned has now been guaranteed by H.M. Government for a period of five years, from April 1st, 1908. The sum provided during the first of the five years will be £14,420, and the annual provisions will be progressively diminished so as to reduce the contribution to £7,000 in the last of the five years. From April 1st, 1907, the expenditure of the

Department will be curtailed as far as the Commissioner of Agriculture finds reasonably possible, and the Commissioner will, with the Secretary of State's approval, endeavour to obtain progressively increasing contributions towards the cost of local agricultural institutions from such colonies as may be able to afford them. Representations as to the importance of the continuance of the work of the Department have been received by the Secretary of State.—(*Tropical Life.*)

ON THE CAUSE OF COBB'S DISEASE OF THE SUGAR CANE.*

By Erwin F. Smith.

(*Continued from page 584.*)

There is one very interesting symptom to which I have not yet called attention, nor is it mentioned by Cobb. I refer to the red fibres. We have heard a great deal about red fibres in conjunction with the Sereh disease of the sugar cane in Java, and in fact a red coloration is known as a subordinate oxidation phenomenon in many diseases of the sugar cane, but I have never seen it more beautifully developed than in connection with the canes inoculated with bacteria. In the diseased plants of "Common Green Cane" which were inoculated from pure cultures, without exception, numerous blood-red fibres were to be seen. It was a very striking symptom of the infestation and could not be assigned to any other cause.

Whence arises this pigment in the fibres? Coloration of the fibres is not unknown in bacterial diseases. It occurs in connection with *Pseudomonas solanacearum;* again in plants of sweet corn, whose leaves have been inoculated with *Pseudomonas Stewarti*, we notice a fibre disease with an enormous multiplication of bacteria precisely as in the case with *Pseudomonas vascularum;* but in the former case, the fibres take on a brown colour, which, in the first internodes, *i.e.*, those longest in the grip of the disease, can also be observed in the parenchyma. In precisely the same manner, as it appears, under the influence of bacteria, probably working however upon other materials, some fibres in the sugar cane take on a red coloration. I consider this a deterioration phenomenon of the host. According to Prinsen Geerligs, there exists in the cellulose of normal sugar cane a neutral, colourless material, soluble with difficulty, which in alkali takes on a yellow colour and on access of air becomes red and finally brown. The nature of this substance is unknown. In such fibres, for the most part, but not always, bacteria were no longer to be found. In their places, however, formless red masses were to be seen. Red and yellow fibres were scattered through the stalk, and often the same fibre was speckled. The same thing occurs in maize when it is inoculated with *Pseudomonas Stewarti*, but in that case the yellow is mixed with brown. The red pigment was most abundant in the nodes and in the portion of the internodes close by. The coloration of the pigment in and near the nodes was noted in many cases.

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* "From Gumming of the Sugar Cane." Hawaiian Sugar Planters' Association Bulletins.

In all cases there was more pigment in the upper than in the middle or lower end of the internode, but the greatest amount at the nodes, where very often many or even nearly all of the vascular bundles were red as blood. Many chemical analyses of various parts of the sugar cane have been published, but perhaps none of the varying collection of organic compounds can throw much light on this peculiar phenomena. Perhaps however it is connected with a greater aeration through the leaf fibres in and immediately under the nodes than above them. In cane, as in maize, the pigment seems not to appear in the early stages of the invasion, but to the greatest extent when the fibres have been diseased for some time. Still one cannot assume that the reddening of the fibres is a symptom peculiar to the gumming disease. It occurs in other diseases, as I myself have observed on West Indian plantations. In order to be certain in the identification, one must find the yellow bacterial gum in the vascular bundles, which is usually easy in this disease. Only in cases where it is poorly developed in resistant stalks, is there any difficulty in recognising the disease. Perhaps the formation of the pigment is not so prominent in all varieties as it is in the "Common Green Cane."

Somewhat later, under the same conditions, two other varieties of sugar cane were inoculated, namely: "Louisiana No. 74" and "Common Purple Cane," the favourite sugar cane of the United States; but with quite different results, Both varieties were very resistant to the disease. With the exception of a few clear but restricted or slowly appearing symptoms in the inoculated leaves and on a few other leaves, there were no outward symptoms, nor did they occur in the interior of the stalk, or if so they were much less pronounced than in "Common Green Cane." As a rule, the inoculated stalks were finally somewhat dwarfed, although at the beginning they might have been the strongest.

What is the origin of immunity to this disease? or wherein lies the susceptibility? This is a very interesting and perhaps also a very complicated problem. Only a few remarks may find place here. Before I conducted the inoculations described above, I titrated the freshly expressed juice of well-grown sound stalks of all three sugar canes which I had at hand against alkali with phenolphthalein in order to test their acidity. According to these titrations, the juice of the "Common Green Cane" showed by far the smallest degree of acidity. Also in sterilized vessels slices of the "Common Green Cane" constituted a culture medium upon which the *Pseudomonas vascularum* throve much better than on slices of the other cane varieties. All the slices were cut obliquely, placed in a small quantity of distilled water (only the underside), and during three days daily heated a few minutes in a steam sterilizer. It was this unexpected result which decided me to take the "Common Green Cane" as the first inoculation material. I considered the cane to be more susceptible than the other varieties, and so indeed it finally turned out. The other varieties were a hundred, yes, a thousand fold more resistant to needle infections with the organism. For the most part they showed only local symptoms on the inoculated leaves or stems. No symptoms were noticeable upon the other stems of the inoculated cane stool, even after many months. Some of the inoculated stalks indeed showed a dwarfed growth with secondary symptoms upon the leaves, but after six months, when they came to be sliced up, for the most part there were only a few red fibres to be seen in the stems, but in two of the stems there was also a very small number of fibres with yellow gum. These red fibres occurred only in the nodes and internodes in the neighbourhood of the inoculated leaf, and were for the most part to be found in the well-developed stalk neither above nor below. We can tabulate these facts somewhat as follows:—

VARIETY.	Acidity of the Sap in Cubic Centimeters of Normal Sodium Hydrate pro. 1.	Growth of the Bacteria upon Water Sterilized Slices of the Cane.	Susceptibility to the Disease.
Common Green Cane	19·00	Good	Very high
Common Purple Cane	..	Poor	Very low
Louisiana No. 74	31·00	Poor	Very low

It should be here remarked that the "Common Green Cane" is the cane that is most widely cultivated for eating, which would not be the case if the sap was very acid. A sugar chemist with whom I have spoken about the matter considers that trustworthy results are not to be deduced from single stalks. According to his opinion, very likely the next titration might have given another result. In order to decide the comparative acidity of the sap of various cane varieties, the test must always be made with mixed sap from numerous stalks of each variety. I say nothing against that. It may well be so. So much depends upon changeable factors—for instance, the soil, the manure, sunshine, rain, time of the year, ripeness, location, &c. I do not know, however, whether any chemist has tested the sap of various varieties of cane with reference to their grade of acidity. From a pathological standpoint I think that this would be a very interesting test. Many bacteria do not thrive well upon acid culture media, and often a slight excess acts as an antiseptic. Furthermore, that some varieties of sugar cane possess a higher grade of acidity in the stem than other varieties, corresponds well with many facts in plant physiology, and perhaps the high susceptibility of some cane varieties to this parasite is accounted for simply by the low acidity, or a minimum of a specific counteracting acid. The immunity is very clear, whatever the explanation may be. My own infection experiments are not the only proof. Cobb had already in the year 1893 remarked the resistance of some varieties and recommended them for counteracting the disease in the plantations. During the last year he has written that in so far as his advice was followed, the disease has diminished. We have therefore the best proof that this disease is easy to overcome through the cultivation of resistant varieties. All plantation managers who suffer from this disease should at least give to this method a careful trial.

There remains only the question of Sereh. Is this Australian gumming disease the same as the Javanese "curse" of the sugar cane? The symptoms are for the most part very similar—for instance, red vascular bundles, dwarfed growth, shrinking of the internodes, albinism, shooting of the buds, propagation by means of infested cuttings, club-shaped terminal buds, &c. As I have never seen Sereh, I cannot say anything about it. Valeton, Janse, and Krüger have considered Sereh as a bacterial disease of the vascular bundles, but I do not know whether they have seen the yellow gum in the bundles. So far as I have read, they speak only of a red gum. Von Wakker, Went, and others have combatted this opinion. Went has, however, in view of his observations in the West Indies, during the last year withdrawn his former views with regard to a fungus mycelium as the cause of Sereh. It seems fairly well established that Sereh occurs not only in Java (according to Krüger, also in Borneo, Mallacca, and Banka); and Cobb's disease is not confined to Australia, prevailing also in Java, Mauritius, and Brazil. It would be very useful if a competent bacteriologist should make a new and thorough-going study of Sereh in Java. A disease that is so widely prevalent among sugar cane is of general interest. Possibly two or more different diseases are united under the same name, whereof one may be of bacterial origin.

Addendum.—As I have been very much occupied with other affairs, this manuscript has remained on my table for a year, and in the meantime the above-mentioned pure cultures have been inoculated into other plants, which are now diseased.

1st October, 1904.

The world's total of exports and imports has increased from £800,000,000 in 1850, to £5,300,000,000 in 1905. Truly a prodigious increase.

QUEENSLAND.

The Government Central Sugar Mills.

Dr. Walter Maxwell's Second Annual Report on the conditions and operations of the Government Central Sugar Mills in Queensland has lately been issued, and contains much detail of considerable interest. It should be explained that these Central Mills are such as have failed to meet their obligations to the Treasury, and the management of whose affairs has consequently passed absolutely under the control of the Government. Such mills include the Nerang, Moreton, Mount Bauple, Gin Gin, and Proserpine Central Mills. It may be added that the mills which have so far met all their obligations, and have retained their independence, are the North Isis, Mulgrave, Mossman, Racecourse, Marian, Plane Creek, and North Eton Double Peak Central Mills. Certain of these latter have, moreover, strengthened their financial position the last year. It is the first-named list of mills with which the report is concerned, and below will be found summarized or reproduced, such portions of general interest as we can find space for.

The original ownership of the mills was lodged in the central mill companies, and these were constituted of shareholders who represented that proportion of the Treasurer's security which is furnished by the mortgages over lands. In addition to being the owners of the mills and sureties for the moneys advanced by the Treasury for their erection, those shareholders were to be the producers of cane, and, through their directorates, the manufacturers of the sugar. At those mills that are now in possession of the Treasurer, in addition to the directorates proving to be inefficient manufacturers, the shareholders failed to produce sufficient supplies of cane; and, as the companies, despite the utter inability of their shareholders to produce the crops themselves, offered too little inducement to farmers who had no share or concern in the mills to grow the cane for them, the mills, from lack of crops, came into default.

But since the Treasurer has been in possession of given mills the number of cane growers has increased by 72 per cent.; and as a result of this increase of growers, together with the benign character of the recent seasons, the production of cane has enormously increased. As a result of the increased production of cane, with a more careful and technical control of the manufacture, the mills have been enabled to restore themselves to a state of greater working efficiency, and also to liquidate notable amounts of arrears of payment. As the present improved financial state of the mills is thus largely due to the greater number of settled cane producers in the field, it is reasonably safe to assume that the increased earning power of the mills is likely to be more permanent.

These considerations are clearly of importance. The principal factor on which permanent business success depends is evidently the production of the raw material in the fields. As the number of producers is governed by the conditions of treatment they receive, individually and collectively, the inducements to be held out to them are a matter of no small concern. Yet at present the number of non-shareholders who supply cane to the mills greatly exceeds the number of shareholders, and at three at least of the mills it has been the non-shareholding cane-growers who have enabled the concerns to run at a profit. As an instance, Moreton Mill may be cited; in 1905 32 shareholders supplied 11,113 tons of cane, while 191 non-shareholders accounted for the delivery of 30,675 tons, or nearly three times as much.

The foregoing considerations, and others arising out of them, are recapitulated in the report as follows:—

That during the period that these mills were in the hands of the companies they notably failed in the conduct of the business, and made default in their obligations to the Treasurer.

That the chief cause of the default was the small number of cane producers. The shareholders were quite unable to grow an adequate supply; and their directorates did not offer such terms as would induce a sufficient number of non-shareholding farmers to become growers of cane. That, upon the Treasurer entering into possession of the mills that had made default, the differentiation that had existed between the shareholding and non-shareholding growers was swept away, the price of cane, and all other terms and privileges, being made equal to all producers alike.

That as a result of the policy put into operation, and made to apply to all the growers equally, a great increase resulted in the number of growers, amounting in three years to not less then 72 per cent., and the increase is still in continuance.

That in 1905 the number of shareholding growers at the five mills was 160, and their cane supplies amounted to 54,007 tons, or 46 per cent. of the whole, which amount is totally inadequate to enable the mills to operate at a profit.

That in the same year, 1905, the number of non-shareholding growers was 329, and their supplies amounted to 62,905 tons, or 54 per cent., which proportion is still growing. During 1906, the number of non-shareholding growers has increased to 390, and constitutes at this time 71 per cent. of the total body of suppliers. It is due to the supplies of the non-shareholding growers that the mills are being enabled to operate at a profit, and without their production they would have to close down.

These deductions from the facts, as already said, have an acute bearing upon the question of ownership of the mills.

The companies have made default, and have legally forfeited their right to own.

The Treasurer is now in possession, representing and protecting the public taxpayer, whose moneys established the mills. It is apparent that at this time the ownership should rest with the State, and until the public moneys have been redeemed.

When the State has recovered the moneys advanced, the ownership of a mill can be made over to the whole body of its growers of cane upon a basis of co-operation; each supplier's share in the mill being proportional to his guaranteed supply of cane.

If the Treasurer possesses and conducts the business of the mills, and is enabled, by the aid of the non-shareholding producers of cane, to free them from all their obligations to the public taxpayer, then the conclusion that is most apparent is that the mills should not be handed back to the original owners, who had brought them into default.

The Comptroller has submitted to the Treasurer proposals which can form the basis of an arrangement that will cover all the conditions of the situation, and that shall be permanent. The end that these proposals have in view may be stated generally as follows:—

The absolute ownership by the State of the mills, of which the Treasurer is now in possession, until such time, at least, that a mill has repaid all moneys owing to the Treasury.

The execution, by canegrowing mortgagors, of guaranteed agreements to grow cane, providing such instruments are declared valid, and the releasing of the mortgages over their lands.

The organization of new companies after the Treasury moneys have been totally repaid, which new companies shall include all cane suppliers, and none other than cane suppliers; and each grower's interest and share-ownership in the mill shall be proportional to his guaranteed supply of cane, according to conditions that shall be determined upon.

The strongest evidence of real development in the agricultural side of the central mill work is the increase in the number of farmers who are now engaged in cane production. At the five state-owned mills there were, in 1903, 315 growers, and in 1906 this number had increased to 542. The subjoined table gives the figures in detail:—

NUMBER OF CANEGROWERS AT THE MILLS IN THE POSSESSION OF THE TREASURER.

Mills.	1903.	1906.
Moreton	117	251
Proserpine	83	114
Gin Gin	47	76
Mount Bauple	44	55
Nerang	24	46

Another reason for satisfaction is to be found in the increased tonnage of cane produced and delivered to the mills. Thus, in the case of Moreton, the increase has been from 17,000 tons in 1903 to 40,000 tons in 1905. The Proserpine crop in 1905 was over 26,000 tons, and promises this year to be 20% greater. The 1905 Gin Gin crop, however, suffered greatly from unprecedented frosts.

The Comptroller being anxious to establish a uniform system of management and, as far as conditions will allow, a uniform method of conducting and recording the practical operations of the several mills, he placed control chemists at each mill with uniform instructions as to methods of analysis, and forms of calculating and presenting results. Uniform lines were also laid down along which the several managers were advised to carry on the practical work of their mills. These dealt with the harvesting of the crop (method of cutting, mode and cost of transport, &c.), the quality of the crop, the details of manufacture, the shipments of sugar, the work of off seasons, and the labour. Below will be found the report of the Moreton Central Mill, the largest one of the six.

MORTON CENTRAL SUGAR MILL.

Harvesting of the Crop.

41,675·26 tons of cane were supplied by 192 European and 31 kanaka growers (kanakas are tenants of large landlord mortgagors), the majority of the farms being of small area and distributed over a very large extent of country. The harvesting was done by the growers themselves, who in some cases employed hired assistance, while in a number of cases sufficient labour was available in the growers' own families.

The transport of the cane on the Upper Dulong, Image Flat, Perwillowan Creek, Coe's Creek, and Paynter's Creek branch lines was done with horse teams (employing some 40 horses), drawing the loaded trucks to sidings accessible to the locomotive which took them to the mill yard. All along Petrie's Creek, and on portion of Lower Dulong, the haulage was done by locomotive power (the hauling on the portable line in the fields is done by horses employed by the farmers themselves, and is, therefore, not included here). Cane harvested along the main North Coast Railway line was brought in every night by Government railway, in trucks having a minimum load of 5 tons. Only 300 tons of cane was delivered at the mill carrier by drays.

The cost of transport is made up as follows:—

	£	s.	d.
Paid to teamsters	997	1	1
Paid to railage	559	14	2
Cost of running locomotive and trucks	365	0	4
Damage to trucks	50	0	0
Horse feed	78	5	6
	£2050	1	1

Character of the Crop.

Acres cut:—

471	plant cane twelve to fourteen months.
817	over sixteen months.
1215	ratoons twelve months and under.
2503	acres.

The Upper Dulong cane fields are some 800 feet above sea level. The land there is undulating, and has a dark grey colour, with a depth of from 1 to 3 feet, having a subsoil of decomposed stone of a shelly nature. The analyses of samples of cane from that locality give 17·88 Brix, 14·68 sucrose, 82·10 purity.

The Lower Dulong cane fields comprise a portion of the lower slopes of that range, which in soil very much resembles the upper part, while the balance is flat, with a much darker soil, having for subsoil a stiff clay, producing a cane, according to some samples analysed, of 17·94 Brix, 14·04 sucrose, and 78·26 purity.

The Petrie's Creek cane fields are mostly situated along the banks of that creek, and the soil there is of a dark loam, having a clay subsoil. The analyses of cane taken from that locality give 17·74 Brix, 13·86 sucrose, 78·12 purity. (Note.—These analyses are from samples taken in the field prior to the crushing of 1905.)

The cane fields at Yandina (71 miles) and Northam comprise a very large variety of soils—red, brown, and black—and are mostly flat lands suffering very much from frost, and on that account producing cane of a low density.

The condition of the cane delivered was good in respect of topping and trashing. Only in two cases was it found necessary to return to the owner a portion of the cane sent in.

The price paid to the grower for cane was 10s. 6d. per ton on trucks on the line. In accordance with the Comptroller's ruling, excess of freight over 1s. 6d. per ton on the Government railway was deducted from the price of the cane.

Manufacture.

Crushing was commenced on 6th June, 1905, and finished on 6th December, 1905. On account of the large crop, and its frost-damaged state, the work was very much forced through the whole season, and the rollers were kept grinding 23½ hours out of the 24. During the very cold nights, also towards the end of the week, when the tubes began to get dirty, the boiling of the clarifiers was retarded, and the addition of another clarifier was felt a necessity. The continuous subsider proved rather insufficient for the treatment of the juices, more particularly when working bad cane. An alteration made caused better results.

The extraction at the rollers for the season was 90·05 per cent. of the sugar in the cane, with a maceration of 16·63 per cent. applied at the first mill. Better results would have been obtained if the work had not been so much forced, but the Comptroller's instructions were "to avoid any loss to the farmer by fermentation of frosted cane in the field, and that the crushing had to be pushed with all reasonable speed."

The evaporating results of the triple effets is the controlling factor of all other stations in the mill. The density of the syrup supplied to the pan averaged 59·92 Brix, or an efficiency of ·602 at the triple effets.

The vacuum pan also was very much taxed, and under the circumstances did good work. The syrup was boiled to grain in the usual straight-out method, and the pan discharged when full, giving first massecuite.

When sufficient molasses had been stored, a small portion of the first massecuite was left in the pan, which was filled up with first molasses (*i.e.*, results from first massecuite). Eighty per cent. of this pan was then discharged, and called second massecuite, and the pan was again put in motion with its 20 per cent. of contents, and filled up with second molasses, (*i.e.*, results from second massecuite), after which the whole mass was discharged, and called third massecuite (branded No. 1 or No. 2, according to quality).

The third molasses (*i.e.*, results from third massecuite) was boiled to string, and put into coolers for jelly sugar (X brand). This latter was put through the centrifugals, according as the room occupied by it was required. On account of the poor and insufficient storage capacity for that class of sugar, it had often to be disposed of before it was ripe. Additional tank capacity, the Comptroller states, is to be made.

The branding of the raw sugars was done according to quality, and resulted as follows;—

3,555·50	tons of	97·98 pol.,	branded	No. 1—	89·8	per cent.	of total
263·90	do.	97·09	do.	No. 2—	6·6	do.	do.
142·94	do.	88·20	do.	X—	3·6	do.	do.
3,962·34	tons, averaging 9·45 net titre				100		

Four centrifugals, 30 inches by 14 inches, worked on massecuites direct from the pan, and gave an output of 3,819·40 tons of Nos. 1 and 2 during 143·63 shifts, or 26·59 tons per double shift.

Two centrifugals, 30 inches by 14 inches, on account of their position, could only be utilised for the jelly sugars, and were worked only when required. They dried 142·94 tons of X sugar.

The analyses of the various brands were:—

No. 1.—97·98	polarization	·63 water
No. 2.—97·09	do.	·87 water
No. X—88·20	do.	2·59 water

SHIPMENTS OF SUGAR.

The sugar was trucked from the mill sugar-room into the Government railway trucks on the mill-yard siding.

OFF SEASON.

The work done has been as follows:—

Mill Buildings and Machinery.—The cane carrier has been repaired; two new rollers have been procured and fitted in; general repairs done to both mills; the old rollers turned and grooved; a new chain procured for the intermediate carrier; the megass elevator and conveyor repaired; brickwork of one boiler renewed and balance patched up; the boilers cleaned and painted internally; boiler feed and juice pumps repaired; position of the juice meter altered; clarifiers overhauled and additional one erected; nest of four settling tanks with necessary staging added; triple effets overhauled and new tubes put in; the various syrup and liquor tanks made tight; new joints in vacuum pan and coils repaired; centrifugals overhauled and some spares procured for them; centrifugal engine repaired and made stronger; staging of the jelly tanks attended to; a stronger engine put in to drive the dynamo on account of the increased demand on the lights; steam traps put at required points; the whole of the pumps and engines overhauled; interior of the tanks painted; new joints made over the whole mill; patches of steam pipe, which required covering, attended to; chimney painted;

presses, also staging and chutes for the refuse, repaired; whole of the valves and cocks ground; waste water drains repaired; new floor put down in the laboratory; half of the sugar-room floor renewed; spouting around the mill, together with the guttering between the main building and the crushing shed, repaired and renewed; new concrete floor laid around the centrifugal portion of the mill; a stone pavement put at the bottom of the water tower, and a brick wall 12 inches deep built around its water basin.

The former dynamo engine has been erected to drive the workshop, a new drilling machine added, and some sundry necessary tools purchased.

The old office has been shifted, and is now used as a store for the engineering, mill, and kitchen supplies and navvies' tools, &c.

A new office with better accommodation and a fireproof room has been erected. The dining-room has been enlarged, and the men's quarters repaired and thoroughly disinfected and made ready for occupation.

Rolling Stock.—The locomotive has been overhauled and sundry improvements effected to it. The old trucks have been repaired, and some renewed. Fifty additional new trucks have been arranged for, and twenty old trucks have been purchased.

Tramline.—The whole of the lines have been chipped; some 30 chains from the mill gate towards Petrie's Creek has been renewed and properly ballasted; the main line has been lifted, packed, and ballasted where most urgently required; a new branch with a weighbridge has been put down in the mill yard for firewood and also empties during the night; twelve points and crossings have been purchased, and nine have been put down at places most convenient for the working of the locomotives; a number of sleepers and also two bridges have been renewed; several culverts have been repaired; 2¼ miles of line towards the terminus at Dulong has been lifted, packed, and ballasted (this work having been left unfinished until then). *On account of the farmers*, some 3¼ lines of portable line with six switches have been procured and delivered accordingly; a new bridge has been built across Petrie's Creek, near Perren's barn; and a new route is being formed and laid towards Dalzell's.

LABOUR.

White labour only was employed, averaging 95 hands in the crushing, and 40 in the off season.

The efficiency and conduct were good.

Married men were allowed to reside at their homes, and receive a board allowance. Other labourers were provided with food and sleeping accommodation.

GENERAL.

The winter last year was a long and severe one, frost being recorded up to November. From June to December last, the weather was exceptionally dry also, which made it favourable for harvesting, and no serviceable rains for the crops were experienced until the last days of December. On account of this dry spell and cold weather, the early cut cane has ratooned badly, and had to be ploughed out in places.

Last August cane plants of the Goru and Innis varieties, previously sent to this District by the Comptroller, were distributed from the mill experimental plat amongst 140 growers, and the reports received so far from those growers are very favourable. A small quantity of these varieties was left to stand over as an experiment, and was cut within the last two weeks, giving a return of 24 tons from half an acre. During that same month two other varieties—Setler's and Bois Rouge—were received from the Mackay Experimental Station, and planted; but, on account of the dry weather at that time, some of the plants did not come up, and the misses were filled with the Goru variety. It is all looking very well just now, and will be ready for distribution among the farmers in a few months.

A property owned by Mr. H. E. Lowe, and adjoining the mill on the south side, and through which property the discharge from the mill boilers passes, was purchased by the mill to avoid any further complaint, and to also allow of the closure of part of a road existing between the two properties which, for the mill convenience, was absolutely necessary.

Portion of another road, which ran through the middle of the mill yard, has been proclaimed closed also.

Since January this year, the weather has been very favourable for cane-growing, and, although rather wet for good cultivation on low lands, the crops generally have made very rapid growth.

The tramline and bridges suffered some slight damage through the heavy rains in February and also in May last. The latter rains have flattened many canefields, which will suffer severely if frost is experienced.

Tenders were closed for the supply of 1675 cords of firewood, and 1300 cords have been delivered up to date.

Tenders have been satisfactorily closed for the supply of kitchen stores' beef, and bread; and also for the tramming of the cane on the several branch lines.

Weather.—The rainfall for the year under review was as follows:—

July to December, 1905	10·82 inches.
January to June, 1906	46·62 ,,
Total	57·44 inches.

W. E. Desplace.

The new Vancouver-Fiji Sugar Company will shortly have 10,000 acres under cultivation in the Fiji Islands. In order to provide easy communication with the mill, it has been found necessary to construct a steel bridge (900 ft. long) over a river.

According to the *Anglo-Japanese Gazette*, the native Chinese engaged in the sugar industry in South Taiwan, Formosa, are gradually being drilled into modern methods, and with the experience thus gained it is anticipated that there will be a larger demand for up-to-date machinery, and that eventually there will be a regular central factory system.

ON THE PERCENTAGE OF FIBRE IN THE SUGAR CANE; THE COMPOSITION OF SAME, AND ITS VALUE AS FUEL.

By H. Pellet.

Mr. Prinsen Geerligs has recently published a very interesting paper on the composition of the fibre of the sugar cane (*Archief voor de Java Suikerindustrie*, 1906, No. 7), which we proceed to examine, adding our own observations on the subject.

Mr. Geerligs refers to the fact that the percentage of fibre varies greatly in different varieties of canes; being 10%, for example, in the Cheribon Cane, and as high as 17% in certain other varieties, whilst an average of 13% was obtained for an entire crop. He adds that the fibre varies in quality as well as in quantity, it being a familiar fact that, under the same milling conditions, some canes are more easily crushed than others, so that the yield of juice is very variable. Not only is this observed with different varieties of cane, but even with the same variety in different years and at different stages of maturity. This is very apparent in the case of the three varieties grown in Egypt—the white, red, and ribbon canes—when these are tested at the commencement and termination of the manufacturing season. But if one variety of cane yields more or less juice under the same pressure, this must be due either to variations in the proportion of juice in the cane or to the physical qualities of the fibre (when the quantity of juice does not vary); upon this, opinions cannot differ.

Mr. Geerligs states that varieties rich in fibre which is also tough, generally yield a drier megass containing less sugar. It is easily understood that a cane, yielding the same weight of juice as another cane of lower fibre-content, must leave a megass containing more fibre and less juice.

In connection with the estimation of fibre in the cane, Mr. Geerligs denies the objections made by MM. Pellet and Naus to the use of alcohol, since in Java the greater part of the juice is first extracted from the megass by pressure, the alcohol cannot then precipitate the organic impurities, and thus increase the weight of fibre, as MM. Naus and Pellet supposed.

Obviously, there is less chance of error if much of the juice is eliminated before alcoholic treatment, but whether due to the small quantity of juice remaining in the pressed megass or to the fact that perhaps the sugar is not completely extracted by the alcohol, the alcoholic method does occasionally give high results. Aqueous extraction in Zamaron's apparatus appears to be simpler and less liable to error, especially in laboratories where the analytical work is done by assistants, and not by the chemist himself.

Mr. Geerligs has determined the percentages of ash, water, and silica in several samples of fibre received from different factories, the silica being supposed to be detrimental as regards the value of the megass as fuel. In his opinion the softer varieties of fibre should contain more pentosans and gummy matter (xylan); and, being more spongy and retentive of water, would be more difficult to burn and furnish less heat in the furnaces. He gives the following figures:—

Variety of Cane.	Xylan % in dry fibre.	Xylan % in organic matter in dry fibre.
Cheribon	20·97	22·78
Preanger	22·49	24·74
No. 100	21·82	24·16
,, 36	22·21	24·02
,, 247	22·73	24·71
,, 105	20·73	23·04
,, 139	22·19	24·49

These varieties are precisely those which give trouble in the furnaces, and it will be seen that the percentage of xylan varies very slightly, but was not determined in all the samples of fibre analysed by Mr. Geerligs as was the percentage of cellulose. For the latter Mr. Geerligs employed Weender's method, boiling 3 grams of fibre with 1·25% sulphuric acid for one hour, washing, then boiling with 1·25% soda for one hour, washing first with water, then alcohol, and finally ether. The dried residue was weighed before and after ignition, the loss in weight being taken as pure cellulose.

Mr. Geerligs also analysed 58 samples of megass obtained from very different varieties of cane:—Manila, Cheribon, Préanger, Guinée, together with the seedling varieties Nos. 33, 36, 81, 86, 100, 124, 125, 135, 139, 142, 143, 146, 147, and 247, and these gave the following variations:—

	Maximum.	Minimum.
Fibre per cent. in cane	8·24	19·1
Sucrose	2·92	8·34
Water	39·25	52·51
Ash	1·04	4·91
Silica	0·75	3·88
Cellulose, pure	43·43	61·08
Weight of megass per 100 cc.	5·09 gr.	11·12 gr.

It is impossible to conclude from these figures that the observed differences in the fuel value of different samples of megass are due to the percentage of pure cellulose.

Finally, Mr. Geerligs had the calorific power of the specimens determined by MM. Konig and Bienfait, from whom he received the following data:—

CANE FIBRE.

				Calories per kilogram.				
		Water. (1)	Ash. (2)	Moist Megass. (3)	Dry Megass. (4)	Dry Organic Matter from 2 & 4. (5)	Dry Organic Matter. (6)	Dry Organic Matter from 2 & 6. (7)
Cheribon	1903	9·60	2·05	4215	4660	4755	4540	4635
No. 247	1903	9·12	1·85	4270	4700	4789	4625	4712
,, 36	1905	8·32	1·42	4275	4662	4736	4539	4634
,, 100	1905	8·46	3·03	4196	4583	4742	4442	4581
,, 105	1905	8·64	1·79	4231	4630	4724	4514	4596
,, 139	1905	9·26	1·42	4189	4627	4690	4368	4430
Cheribon	1905	8·69	1·68	4318	4730	4823	4530	4607

From these results the author concludes that the calorific power of different samples of megass varies but slightly from year to year, and does not account for the variable results observed in practice. Wishing, however, to study the question more thoroughly, he had the following detailed analyses carried out by Mr. H. Wertkamps:—

Variety of Cane.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	CALORIES (calculated from preceding Table.) From (5).	From (7).
No. 36	48·45	6·45	44·94	0·16	4736	4634
,, 100	47·88	6·55	45·39	0·18	4742	4581
,, 105	48·14	6·43	45·25	0·18	4724	4596
,, 139	47·13	6·30	46·43	0·14	4696	4430
Cheribon	46·82	6·67	46·33	0·18	4823	4607

From the elementary constituents of the organic matter of the megass samples, as here indicated, no further conclusions can be drawn as to the variations in the fuel value of megass.

The ashes obtained during these analyses were united and analysed, with the following results:—

Silica	80·57
Phosphates of lime and iron	6·87
Carbonate of lime	0·86
Carbonate of potash, &c.	11·70
	100·00

Mr. Geerligs found that the megass which gave the best results as a fuel contained the most silica, but the differences were too small to account for the very different results obtained with these fuels.

The author then examined the megass samples from a physical point of view, and found that the weight of a known volume (100 cc.) of slightly compressed megass was less in the case of megass of inferior fuel value. On the other hand, he remarks that that variety of cane which furnishes a satisfactory megass fuel is generally rich in cellulose, and he comes to the conclusion that the cane which contains the most fibre also contains fibre of the best quality as regards fuel-value. The following figures are extracted from Mr. Geerligs' paper:—

Variety of Cane.	Fibre per cent. in Cane.	Number of Tests.	Weight of a Volume of 100 cc.
No. 100	9·70	3	5·45
Cheribon	10·38	9	6·71
Manila	11·80	3	6·38
No. 247	13·85	8	6·97
,, 139	14·16	5	7·30
,, 33	15·59	3	7·23
,, 36	15·72	8	7·95

The conclusion drawn therefrom is that the volume of the fibre remains fairly constant, but that its density is higher in proportion as the cane contains more fibre. It may thus be explained why certain varieties of cane of low fibre-content, and in which the fibre is soft, give an inferior extraction to canes rich in fibre which is also tough. The more spongy fibre re-absorbs a larger quantity of juice the moment it leaves the mill.

Mr. Geerligs states that the method of analysis he employed does not yield pure cellulose, and here we would remark that in the determination of cellulose in megass, and in fodder, errors occur with the same sample, according to the analytical method adopted; the results being only comparative in the same laboratory. We, ourselves, have also determined the percentage of actual cellulose in cane fibre, and obtained different results when the conditions of the experiment were varied. In the case of feeding stuffs, the analytical differences were still so great that at the Sixth International Congress of Applied Science, held at Rome in April and May, 1906, M. Menozzi introduced a new method of estimating cellulose, at a meeting of the International Commission for standardizing the methods of analysing fertilizers and feeding stuffs. This method had been tested by several of Menozzi's colleagues, working with the same sample of fodder. Consequently, this method might be employed for ascertaining the true cellulose contents of the sugar cane.

In the case of Egyptian canes, our own figures for cellulose per 100 parts of fibre are generally lower than those of Mr. Geerligs, but we repeat that the methods of analysis are not identical. Hence, the importance of deciding which method should be used.

Comparing the calorific power of megass with that of different varieties of woods, Mr. Geerligs concludes that cane fibre may be regarded as young wood, but that the percentages of fibre, of silica, and of cellulose yield no explanation of the great variations in the fuel-value of megass observed in practice. He considers that these variations are mainly due to:—

1. The volume of megass on the grate of the furnace.
2. The volume of air which enters the grate.
3. The draught, &c.

We agree entirely with Mr. Geerligs' views, and that it is impossible to determine the fuel-value of a sample of megass from its analysis; moreover, that the calorific power varies very slightly when expressed on 100 grams of organic matter, and corrected for abnormal percentages of sugar and of ash. Yet we agree with Mr. Geerligs that different samples of megass give very different results in the furnace.

This might be explained by the variations in the amount of moisture, but from a great number of experiments on the industrial value of megass as fuel, made by us during the past twelve years, we concluded, first, that the dry matter may be regarded as wood; and, second, that the quantity of water evaporated per kilogram of dry matter varies with:—

1. The design of the furnace.
2. The ratio of air to dry matter.
3. The quantity of dry megass burned per hour.
4. The draught.
5. The method of introducing the air.
6. The water-content of the megass.
7. The method of stoking the same furnace.
8. The regularity of the stoking.
9. The cleanliness of the megass when this has to be sun-dried in the factory yard.
10. The state of division of the megass; whether the result of milling (with or without maceration), or obtained in the course of direct diffusion of the sliced cane; also, whether the residual juice in the megass is more or less fermented, &c., &c.

Consequently, the proportion of water evaporated varies considerably, amounting in some cases to 30%. When all these influences are duly taken into account, one would see that the quantity of water evaporated is very high, not only in proportion to the dry organic matter in the fuel, but also to the heating surface of the boilers.

Such important questions as these can only be satisfactorily answered by experiments carried out in different factories with the object of obtaining the maximum heating effect per unit weight of well exhausted megass.

Regarding the megass as wood, and knowing that the theory of combustion, as applied to coal and most other fuels, is inapplicable in the case of megass, we have obtained very remarkable results for the evaporating power of normal megass free from sugar.

Moreover, it is possible to express the fuel value of megass in terms of such a well known fuel as Cardiff coal. Thus, the megass yielded by one metric ton of canes (containing 10% of fibre) if deprived of moisture, sugar, and ash, would furnish as much heat as 38 to 45 kilos of Cardiff coal.

Since the fibre content of the cane varies between 8·2 and 19·0%, according to the variety and degree of maturity, it follows from Mr.

Geerligs' observations that the quantity of megass consumed in different factories must also be very variable. Even assuming an average variation of 9·5 to 14·5% on any one plantation, the difference will still be enormous. In fact, assuming that 9·5% of fibre corresponds to 40 kilos of Cardiff coal per ton of cane, then 14·5% of fibre would represent 61 kilos. In order to compare the relative cost of the fuel, it is necessary to know the exact percentage of fibre, more especially when working with canes rich in sugar and containing 13 or 15% of fibre, since with little juice to extract, and that of a relatively high density, an excellent extraction should result.

It is then easily understood why some factories have just sufficient megass for steam raising purposes, whilst others have not enough, and others again have an excess, independently of the methods of extraction and of working up the juice. In a word, a factory where the megass fuel has to be supplemented by wood or cane-trash may be working quite as economically as another factory having sufficient megass, or an excess of same; these differences are solely due to the quantity of fibre contained in the cane. It varies with the species cultivated, and is very probably influenced by the mode of cultivation and the period required for maturing. It is possible that the same variety of cane, if cultivated in Java, Cuba, Hawaii, and Egypt, would not contain the same percentage of fibre, taking the average composition during a campaign.

Nevertheless, in countries where supplementary fuel is scarce or cannot be cheaply transported, it may be advantageous to cultivate a variety of cane rich in fibre. In fact, the cost of fuel and the difficulties of transport are so great in some countries that one has to employ cane-trash. In others, where wood is scarce, the shortage of megass has to be made up with coal, at a very high price.

Mr. Geerligs' figures for the fibre-content of different varieties of cane should considerably modify the co-efficient now used for ascertaining the sugar-content of the cane from that of the juice, since certain factories in Java have recorded as much as 14·80 % of fibre in the canes treated during the entire manufacturing period of 1905. We merely draw attention to the fact that in the record of nearly a hundred Java factories, during the crop 1905, the above-mentioned co-efficient is not related to the fibre-content of the canes, as the following figures show:—

Per cent. Fibre in canes.	Sugar in canes per 100 parts of sugar in juice.	Per cent. Fibre in canes.	Sugar in canes per 100 parts of sugar in juice.
9·62	86·3	11·03	78·9
9·95	83·1	11·88	80·0
10·32	87·3	13·10	77·6
10·39	86·0	14·80	78·6

(*Bulletin des Chimistes.*)

CONSULAR REPORTS.

ITALY.

Venice.—The beet crop was good in 1905. The sugar industry, encouraged and protected by the State, is always progressing. The workmen have improved, and the most modern methods of manufacture are being adopted. The old machines have been replaced by new ones. The cultivation of beet has also developed, but it is still necessary to import the seed from abroad, as, although the efforts to produce it in the country have been promising, they have not yet been entirely successful. The average return for 1 hectare of ground is about 250 kilos., but it may reach 350 kilos. on the fields situated in the Valley of the Po, and on the alluvial lands of its confluents. The average price paid by the factories may be computed to be about 2·20 lire (1s. 9d.) per 100 kilos. Beet cultivation in Italy occupies only about 40,000 hectares of land, as the consumption of sugar in the interior is not more than about 3 kilos. per inhabitant. Attempts have been made to increase beet cultivation by employing the root for the manufacture of alcohol, but it has been alleged that this industry cannot be remunerative unless means can be found to combine with it the making of sugar and molasses. There are at present in Italy 33 sugar factories and five refineries, giving employment to about 12,000 workmen during the crop season, and about 5,000 during the whole year.

CHINA.

Foochow.—Sugar (brown, candy, refined and white) figures in the returns of Foochow import trade to the amount of £96,874 as against £75,583 in 1904, being an increase of £21,291. Most of this comes from the refineries in Hong-Kong, and is said to be of Java origin; but there is also an increasing demand for Formosa sugar, which is reported to be driving the native product out of the market.

The importation of sugar continues to fall off steadily, the entries during 1905 being valued at only £551,312 against £997,341 in the previous year. The Japanese sugar refineries are expanding steadily, and this fact, in conjunction with the increased consumption tax from the beginning of 1905, tended to restrict the import. Some of the importation during 1904, moreover, had been speculative in anticipation of the increased tax, with the result that 1905 opened with an overstocked market. Prices at the outset ruled too high for the demand, and had consequently to fall as the year advanced, leading to considerable loss and bad trade by the end of the year, the depression being further increased by unverified rumours of a proposed Government monopoly. Imports of unrefined sugar (A and B) declined from £775,979 to £502,890, while the relative fall in refined sugar was still greater, from £219,438 in 1904 to £48,000 in 1905. For white refined sugar prices opened between 15 yen 40 sen and 18 yen per picul

(£26 8s. 3d. and £30 17s. 5d. per ton), but the year closed with prices between 14 yen 70 sen and 17 yen per picul (£25 4s. 2d. and £29 3s. 1d. per ton). For brown China the fall was from between 9 yen 10 sen and 12 yen 50 sen per picul (£15 12s. 2d. and £21 8s. 9d. per ton), to 7 and 12 yen per picul (£12 0s. 1d. and £20 11s. 7d. per ton).

SIAM.

In the sugar import, which in 1904 showed signs of diminution, there is in 1905 a large advance. The total, £189,284, is divided amongst the following countries, thus :—

Country.	Value. £
China	7,165
Hong-Kong	20,136
Java	3,132
Singapore	158,851

It is more than probable that a large proportion of the sugar entered as from Singapore is really of Java origin.

MONTHLY LIST OF PATENTS.

Communicated by Mr. W. P. Thompson, C.E., F.C.S., M.I.M.E., Chartered Patent Agent, 6, Lord Street, Liverpool; and 322, High Holborn, London.

ENGLISH.—APPLICATIONS.

22387. The Mirrless Watson Company, Limited, Glasgow. *Process for removing the impurities from cane juice, and apparatus connected therewith.* (Communicated by E. C. Knight, Argentine Republic.) 10th October, 1906.

ABRIDGMENTS.

172868. Alb. Fesca & Co., Maschinenfabrik & Eisengiesserei Aktien-Gesellschaft, of Berlin. *Centrifugal drum for sugar loaves with moulds arranged radially and displaced in more than two rows.* 2nd February, 1905. This centrifugal drum is characterized by the moulding cases arranged in the ordinary manner in sockets at their pointed ends being further held in position by nozzles, bent flat iron struts, and semi-circular cups within the drum casing, with the object of placing opposite the centre of each sugar loaf mould one of the compartments of the middle cleare container provided in a known manner with vertical partitions and an aperture arranged at a suitable height.

172763. Kurt von Niessen, of Roth, near Düsseldorf. *A method of protecting copper or brass pipes in the heaters of the evaporating or heating apparatus employed in the sugar industry from injury by the vapour or deleterious gases contained therein.* April 7th, 1905. In this method of protecting the copper or brass pipes of sugar boiling apparatus, the said pipes are directly placed beneath the upper floor of the heater within a narrow zone, and covered with a casing material which is impervious to, or but slightly attacked by, the vapour and the gases contained therein.

173279. WILHELM WIEHLE, of Ratibor. *A double-edged shredding knife.* 10th May, 1905. This invention relates to a double-edged shredding knife with a fixed central core, and is characterized by the blade or sharpened portions being arranged on two sides lying diagonally towards one another.

21848. C. B. O. SASSIN, of Samarang, Java. *Improvements in mills for crushing sugar cane or the like.* 26th October, 1905. This invention relates to the adaption for pressing sugar cane or the like of a multiple pressure mill of the kind which comprises cylinders variable in number, arranged in two vertical rows and connected in pairs, by gear wheels by which they are given their movement, characterized by the arrangement that it is possible to dispense with the guide plates or bagasse conducting means, and to collect separately the liquid extracted at each pressure.

9205. Dr. E. MONTI, Turin, Italy. *Improved process for the preparation of concentrated worts, juices, syrups, and scented extracts.* 18th April, 1906. This invention relates to a process for the preparation of concentrated worts and juices, fruit syrups and perfumed juices in general, such as lemonade and others, and for the extraction of the cream of tartar contained in grapes, characterized by the fact that the grapes or other fruits are cooled when in as fresh a condition as possible and before pressing them; the juice is allowed to rest, and is filtered in a cooled chamber, it is then concentrated by congealation and displacement of the soluble matters interposed between the ice crystals, the concentrated juice is maintained at a low temperature until it has become perfectly limpid, and it is pasteurised under pressure of carbonic acid, if necessary; and, finally, in the case of grapes, the lees separated by decantation and filtration are collected and pressed for the purpose of extracting therefrom the cream of tartar.

GERMAN.—ABRIDGMENTS.

172210. HANS DANTINE, of Maltsch-on-Oder. *A beetroot washer divided into several compartments by means of transverse partitions.* 13th September, 1905. This invention relates to a beetroot washer which is divided into several compartments by means of transverse inclined partitions, and is characterized by the partitions tapering downwards towards one another, and each of the compartments formed by the partitions being provided with an agitating mechanism, the axis of which lies at right angles to the longitudinal axis of the entire washing trough. In a modified form of construction the agitating devices have different speeds, which diminish from the place at which the beetroots are introduced to the place at which they are discharged.

171197. Dr. Oskar Köhler, of Maltsch-on-Oder. *A method of heating the diffusion battery.* 19th February, 1905. This invention relates to a method of heating the diffusion battery, and consists in the juice employed for. the mashing flowing successively through more than two of the heaters belonging to the diffusion battery before it passes from below upwards in the known manner on to the fresh shreddings, and after the mashing is completed, being forced further to the measuring vessel in the mashing apparatus, which is also in a well known manner, for the purpose of obtaining and maintaining as high a temperature as possible, even in the first diffuser. A modification of the method consists in the diffusers, which are at rest, and in which the mashing is completed, being heated during the mashing of the diffuser, which has been filled afresh with shreddings, by hot air or superheated steam being blown in to them. Another modification of the method consists in the mashing process being carried on in several diffusers simultaneonsly.

173823. Josef Krivenek, of Kieff. *A mould for making sugar in slabs, strings or cubes.* 14th August, 1903. This mould is characterized by removable longitudinal partitions facing one another, in combination with one or more boxes adapted to be inserted parallel to the longitudinal partitions, which boxes, after the charging of the mould, may be removed through apertures of the cover, which is at right angles to the longitudinal partitions, after the substance has cooled and set, leaving a free space for receiving casing cleare in the substance itself.

174167. Dr. Richard Thonke, of Berlin. *A circulating evaporator, more particularly for the sugar industry.* 1st November, 1903. This consists of a heating chamber with an upper inclined tubular cover, in which the fluid emerging from the heating chamber flows in a continuous current compulsorily through a separate chamber, which is not provided with a heating coil, and therefore offers less resistance, and in which apparatus the return flow chamber has only one wall in common with the heating chamber, and under certain circumstances is protected on this wall in known manner from the action of the heating steam. The heating chamber is so arranged that even at the highest level of the liquid it projects beyond the surface of the latter, with the object of obtaining as effective a separation as possible of the returning fluid from the steam bubbles and thus a better circulation.

174274. Gebr. Heine, of Viersen, Rhine Province. *A centrifugal with heating and cooling apparatus located outside the centrifugal chamber.* 2nd March, 1904. This centrifugal apparatus is characterized by the arrangement of heating or cooling devices in the form of spirally coiled pipes, in such a way round a perforated sieve drum casing that the perforations of the drum casing are exposed, whilst the coils of pipe rise to the discharging place of the heating or cooling medium in an opposite direction to the direction of rotation of the drum, in order to assist the speed of flow of the heating or cooling medium by the rotation of the drum.

175109. IVAR FOGELBERG, of Jordberge, Sweden. *An appliance for pressing beetroot on the slicing knife.* 18th October, 1904. This apparatus for pressing beetroot on the slicing knife by means of oblique movable flaps in the root hopper is characterized by the slicing chamber being bordered above and in front respectively by fixed bars supporting the flaps in conjunction with their free swinging end in the lower position, and being so arranged relative to one another, that no interval between the flaps and the bars is formed until the flaps are in their highest position.

NOTE.—Copies of all published specifications with their drawings in these lists can be obtained from W. P. Thompson & Co., 6, Lord Street, Liverpool, at One Shilling a copy for English or American Patents, and Two Shillings for German. In ordering please give number and date.

Patentees of Inventions connected with the production, manufacture and refining of sugar will find *The International Sugar Journal* the best medium for their advertisements.

The International Sugar Journal has a wide circulation among planters and manufacturers in all sugar-producing countries, as well as among refiners, merchants, commission agents, and brokers, interested in the trade, at home and abroad.

Report has it that no sugar is to be cultivated at Ottur, Bengal, next year. The soil has apparently been exhausted, and the outlook is not very favourable.

The report of the Acadia Sugar Refining Company, of Nova Scotia, for the year ending September last shows a profit of $191,654, and a dividend of 3% was declared.

The Mersey Sugar Products Company, with a capital of £5,000, has lately been formed to acquire the business of an invert sugar manufacturer in Marsh Lane, Bootle, Liverpool.

IMPORTS AND EXPORTS OF SUGAR (UNITED KINGDOM)

To end of October, 1905 and 1906.

IMPORTS.

Raw Sugars.	Quantities.		Values.	
	1905. Cwts.	1906. Cwts.	1905. £	1906. £
Germany	4,385,748	7,182,502	2,483,807	3,115,215
Holland	137,359	306,459	84,650	145,826
Belgium	499,522	986,836	310,755	447,542
France	404,116	248,288	235,717	109,225
Austria-Hungary	373,540	190,510	244,871	78,707
Java	1,922,558	304,949	1,307,662	146,522
Philippine Islands	9,023	....	4,840	....
Cuba	....	111,910	....	41,943
Peru	1,081,387	489,297	696,675	221,170
Brazil	93,938	962,748	50,426	377,563
Argentine Republic	....	....	....	....
Mauritius	167,007	127,205	91,001	48,362
British East Indies	256,180	114,491	143,662	47,421
Straits Settlements	187,381	79,192	100,025	31,726
Br. W. Indies, Guiana, &c.	930,915	1,481,980	746,323	786,284
Other Countries	747,325	186,891	500,189	86,800
Total Raw Sugars	11,195,999	12,773,258	7,000,603	5,684,306
Refined Sugars.				
Germany	7,671,223	9,939,454	6,058,245	5,675,288
Holland	1,416,790	2,311,549	1,134,204	1,399,433
Belgium	245,668	395,530	191,041	232,050
France	1,960,018	2,186,391	1,395,893	1,236,724
Other Countries	345,813	782	283,653	479
Total Refined Sugars	11,639,512	14,833,706	9,063,036	8,543,974
Molasses	2,073,149	2,382,673	417,053	457,180
Total Imports	24,908,660	29,989,637	16,480,692	14,685,460

EXPORTS.

British Refined Sugars.	Cwts.	Cwts.	£	£
Sweden	1,003	128	464	115
Norway	17,515	15,906	13,181	9,434
Denmark	75,123	84,250	52,131	42,650
Holland	67,330	66,992	51,256	41,137
Belgium	8,102	9,550	5,022	5,529
Portugal, Azores, &c.	13,088	27,216	9,258	14,828
Italy	8,758	31,494	5,454	15,906
Other Countries	325,038	570,616	272,048	372,814
	515,957	806,152	408,814	502,413
Foreign & Colonial Sugars				
Refined and Candy	21,140	30,868	18,068	19,322
Unrefined	83,994	156,722	57,830	79,996
Molasses	2,752	5,539	840	1,779
Total Exports	623,843	999,281	485,552	603,510

UNITED STATES.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1906. Tons.		1905. Tons.
Total Receipts Jan. 1st to Nov. 22nd ..	1,778,082	..	1,788,163
Receipts of Refined ,, ,, ...	1,855	..	1,433
Deliveries ,, ,, ...	1,836,615	..	1,705,066
Consumption (4 Ports, Exports deducted) since January 1st..	1,891,600	..	1,643,215
Importers' Stocks, November 21st.. ..	None	..	83,097
Total Stocks, November 28th	143,000	..	213,620
Stocks in Cuba, ,, ...	3,000	..	88,000
	1905.		1904.
Total Consumption for twelve months ..	2,632,216	..	2,767.162

CUBA.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1905 AND 1906.

(Tons of 2,240lbs.)	1905. Tons.		1906. Tons.
Exports	945,063	..	1,110,685
Stocks	172,498	..	36,429
	1,117,561	..	1,147,114
Local Consumption (nine months)	32,120	..	32,570
	1,149,681	..	1,179,684
Stock on 1st January (old crop)	——	..	19,450
Receipts at Ports up to September 30th ..	1,149,681	..	1,160,234

Havana, September 30th, 1906. J. GUMA.—F. MEJER.

UNITED KINGDOM.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION FOR TEN MONTHS ENDING OCTOBER 31ST.

	IMPORTS.			EXPORTS (Foreign).		
SUGAR.	1904. Tons.	1905. Tons.	1906. Tons.	1904. Tons.	1905. Tons.	1906. Tons.
Refined	714,587	581,976	731,685	1,066	1,057	1,543
Raw	601,923	559,800	638,663	4,663	4,200	7,836
Molasses	72,435	103,657	119,133	92	138	277
Total..........	1,388,945	1,215,433	1,499,481	5,821	5,395	9,656

	HOME CONSUMPTION.		
	1904. Tons.	1905. Tons.	1906. Tons.
Refined	728,027	583,174	721,802
Refined (in Bond) in the United Kingdom	438,778	460,144	457,036
Raw	106,593	86,695	99,743
Molasses	70,914	102,235	108,126
Molasses, manufactured (in Bond) in U.K.	50,034	45,166	49,658
Total..................................	1,394,346	1,277,414	1,434,365
Less Exports of British Refined......................	25,485	25,798	40,307
Total Home Consumption of Sugar	1,368,861	1,251,616	1,396,058

Stocks of Sugar in Europe at uneven dates, Nov. 1st to 24th, compared with previous Years.

In thousands of tons, to the nearest thousand.

Great Britain.	Germany including Hamburg.	France.	Austria.	Holland and Belgium.	Total 1906.
126	613	529	324	96	1689

	1905.	1904.	1903.	1902.
Totals	1728	1568	2097	1905

Twelve Months' Consumption of Sugar in Europe for Three Years, ending October 31st, in thousands of tons.

(Licht's Circular.)

Great Britain.	Germany.	France.	Austria-Hungary	Holland, Belgium, &c.	Total 1905-06.	Total 1904-05.	Total 1903-04.
1860	1164	636	556	196	4412	3791	4160

Estimated Crop of Beetroot Sugar on the Continent of Europe for the current Campaign, compared with the actual crop of the three previous Campaigns.

(From Licht's Monthly Circular.)

	1906-1907. Tons.	1905-1906. Tons.	1904-1905. Tons.	1903-1904. Tons.
Germany	2,200,000	2,415,136	1,598,164	1,927,681
Austria	1,375,000	1,509,870	889,373	1,167,959
France	750,000	1,089,684	622,422	804,308
Russia	1,350,000	988,000	953,626	1,206,907
Belgium	275,000	328,770	176,466	209,811
Holland	190,000	207,189	136,551	123,551
Other Countries .	430,000	415,000	332,098	441,116
	6,570,000	6,953,649	4,708,758	5,881,333

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